TWENTY-SEVENTH ANNUAL REPORT

OF THE

ONTARIO BUREAU OF MINES

1918

PART I

TWENTY-SEVENTH ANNUAL REPORT

OF THE

ONTARIO BUREAU OF MINES, 1918,

BEING

VOL. XXVII

AND CONTAINING PARTS I, II AND III

PART I

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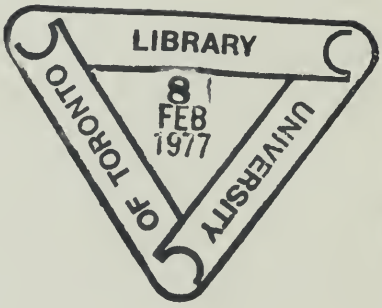

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LETTER OF TRANSMISSION

To His Honour Sir John Strathearn Hendrie, C.V.O.,

Lieutenant-Governor of the Province of Ontario.

Sir,—I have the honour to transmit herewith, for presentation to the Legislative Assembly of the Province of Ontario, the Twenty-seventh Annual Report of the Bureau of Mines.

I have the honour to be, Sir,

Your obedient servant,

G. H. Ferguson,

Minister of Lands, Forests and Mines.

Department of Lands, Forests and Mines,
Toronto, 1918.

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INTRODUCTORY LETTER

To the Honourable George Howard Ferguson, K.C.,

Minister of Lands, Forests and Mines.

Sir,—I have the honour to submit to you herewith, for transmission to His Honour the Lieutenant-Governor in Council, the Twenty-seventh Annual Report of the Bureau of Mines, being for the year 1917.

The Report consists of three Parts. Part I contains the customary Review of the Mining Industry of Ontario for the past year, with statistics of production for the several metallic and non-metallic substances, and a variety of tables giving particulars regarding them. The Review shows that the aggregate value of the output in 1917 was the greatest yet recorded; also that the tendency noted in previous Reports, towards the establishment of refining processes and facilities for manufacturing secondary products, is steadily becoming more marked. With the advantages of ample supplies of raw materials, cheap electric power, and efficient transportation, there is no reason why Ontario should not speedily develop a full-bodied metallurgical and chemical industry, and good progress has already been made to this end.

The Statistical Review is followed by a chapter on Mining Accidents in 1917 by T. F. Sutherland, Chief Inspector of Mines.

Messrs. Sutherland, Collins and Stovel report on the mines, quarries and metallurgical plants in operation during the year.

Arthur L. Parsons, who examined the Slate Islands in Lake Superior, gives an account of the geology of the Islands, and of the veins which attracted considerable attention a number of years ago, but failed to realize the hopes of mineral wealth entertained regarding them.

Mr. Parsons also deals with Mineral Developments in Northwestern Ontario, including the working and opening up respectively of copper deposits at Tip Top mine and near Mine Centre, also with diamond drilling on the titaniferous iron ores of the so-called Fetiva range on the northwest shore of Bad Vermilion lake.

Ogahalla to Collins on the National Transcontinental Railway is the title of a descriptive account by Percy E. Hopkins of the geology of a section of that railway line 175 miles in length from Kenogami river westward to Trout lake, about 35 miles west of Lake Nipigon. The line thus examined connects the great Clay Belt of Northern Ontario where it thins out on the west, with the rocky region into which it merges on the way to the Manitoba boundary. In addition, Mr. Hopkins made some reconnoitering trips into the unexplored territory in the vicinity of Armstrong, a divisional point on the railway.

Mr. Hopkins also contributes Notes on Lake Abitibi Area, having during the latter part of the field season of 1917 examined a considerable part of the shore line of that lake and many of the islands therein, as well as the country adjacent to several of its tributaries, and an area in Rickard township, in all of which localities the rock formations are favourable for mineral deposits and at a number of points have disclosed promising shows of gold.

The Matachewan Gold Area, where gold was found in the autumn of 1916, is described by A. G. Burrows, and the geology of the neighbourhood of the discovery is shown on the map accompanying his Report. For the convenience of prospectors and others interested in the development of this field, an advance edition of Mr. Burrows' Report was issued early in 1918, as Bulletin No. 34.

In Part II, under the title, Sand and Gravel in Ontario, there is a description by counties of many of the detrital deposits which play so useful a part for road and other construction purposes. The author, Auguste Joseph Gaston Ledoux, was professor of mineralogy at the University of Brussels, Belgium, when the great European war broke out. Enlisting in the Belgian army, Professor Ledoux assisted in defending his country against the invading Germans, and was seriously injured in action. Forced to retire from military service, he came to Ontario was taken on the staff of the University of Toronto in 1915 as special lecturer in mineralogy, and was subsequently employed by the Bureau of Mines in investigating these surface deposits. Prof. Ledoux spent the field season of 1917 in southern or older Ontario, to which the account in Part II is mainly confined. It was proposed also to cover the sands and gravels of northern or newer Ontario, in so far as present transportation facilities and knowledge of the territory made this possible. Professor Ledoux had begun work on the northern areas and had made some headway, when further progress was stopped by his sudden death at Sudbury on 7th August, 1918. His treatment of the subject, Sands and Gravels, deals not only with the occurrences, but with the quality and availability of the various deposits for economic uses, such as building, glassmaking, moulding, etc.

Part III, Cobalt: Its Occurrences, Metallurgy, Uses and Alloys, presents the results of an investigation into the properties of the metal cobalt, by C. W. Drury, Professor of Metallurgical Research, Queen's University, Kingston, Ontario. Section I deals with cobalt deposits, the metallurgical processes for recovering the metal from its ores, and the various uses in which it is or may be employed. In Section II there is a study of the effects of cobalt when alloyed with a variety of other metals. In view of the fact that at present the silver-cobalt ores of Ontario furnish the greater part of the world's supply of this metal and the probability that they will continue to do so for some time to come, it seems appropriate to add the results of Professor Drury's researches to the present stock of available information on this subject.

I have the honour to be, Sir,

Your obedient servant,

THOS. W. GIBSON,

Deputy Minister of Mines.

BUREAU OF MINES,
DEPARTMENT OF LANDS, FORESTS AND MINES,
Toronto, 1918.

STATISTICAL REVIEW

of the

MINERAL INDUSTRY OF ONTARIO FOR 1917

By Thos. W. Gibson, Deputy Minister of Mines

In money value the output of the mineral industry of Ontario in 1917 exceeded that for 1916 by 10.3 per cent., being $72,093,832, as compared with $65,303,822. This is the highest figure yet reached for any year. Examination of the statistics makes it plain that the increased value is due more largely to higher prices than to greater production. The effect of the war has been to raise the price of practically every mineral product, with the solitary exception of gold. Increased demand and higher cost of production, both in the main due to the war, have combined to enhance the value of all the items on the list, especially of those substances required for direct use in warfare. In the case of an essential such as copper, the government of the United States deemed it necessary to intervene in order to prevent the price rising beyond all bounds. On the other hand, gold, though sharing to the full in the greater expense of production, was, because of being itself the standard of value, denied the benefit of an increase in price. The natural effect upon the gold mining industry has been to decrease the output, the number of ounces won in 1917 being 76,940 less than in 1916. Silver offers a strong contrast. A small diminution in output was more than offset by a decided advance in price, in consequence of which the mining companies of Cobalt received $16,183,208 for 19,479,692 fine ounces, while in 1916 their return for 20,007,367 ounces was only $12,703,591. Of the other items in the metallic list, cobalt, nickel, iron ore exported, pig lead and molybdenite show substantial increases in value as compared with 1916, while copper, "other" nickel and cobalt compounds, and pig iron from Ontario ore, as well as gold, show decreases due to smaller output. The net result, so far as metallic substances are concerned, is an increase of $1,828,939.

Non-metallic products show in the aggregate a heavy increase in value, amounting to $1,961,071 or 48 per cent., compared with 1916, and in most of the items the larger value was accompanied by an increased production. This is true of arsenic, feldspar, fluorspar, iron pyrites, lime, natural gas, quartz, salt, stone, and talc. For this enlarged output the war was in the main directly or indirectly responsible. Iron pyrites, for instance, was in strong demand to take the place of native sulphur, the supply of which from Sicily to this continent was entirely cut off. The requirements of the steel-making trade for fluorspar brought the Madoc deposits into active operation. More natural gas was used by the munition manufactories of southwestern Ontario. Salt for essential chemical products: arsenic for insecticides to protect precious supplies of growing vegetables and fruit: lime for metallurgical use: talc to take the place of the hitherto imported product: all these and other materials were required in increased quantities, both on this side and on the other side of the boundary line in carrying on the essential work of winning the war.

Table I, which follows, summarizes the statistics of mineral production for 1917, including the number of employees engaged in the several branches of the industry, and the wages paid them:—

TABLE 1.—MINERAL STATISTICS OF ONTARIO FOR 1917

Product.		Quantity.	Value.	Employees.	Wages.
			$		$
METALLIC.					
Gold	ounces	420,893	8,698,735	2,939	3,588,983
Silver	"	19,479,692	16,183,208	2,692	3,011,680
Copper	lbs.	539,540	118,772	115	84,653
Copper in matte (*a*)	tons	21,197	7,842,890	3,356	5,570,587
Nickel in matte (*a*)	"	41,887	20,943,500		
Iron ore (exported) (*b*)	"	136,343	483,690	475	493,078
Pig iron (*c*)	"	49,485	1,016,699	2,895	4,339,136
Cobalt (metallic)	lbs.	396,395	589,290		
Cobalt oxide	"	418,703	533,489		
Nickel "	"	23,748	6,533		
Nickel (metallic)	"	225,480	91,923	391	542,925
Other Nickel and Cobalt compounds	"	393,036	42,026		
Molybdenite (concentrates)	"	77,517	108,501	196	116,382
Lead (pig)	"	1,772,512	172,601	121	85,528
Total metallic			56,831,857	13,180	17,832,952
NON-METALLIC.					
Actinolite	tons	120	1,320		
Arsenic (white, grey and other forms)	lbs.	5,183,145	608,483	(*d*)	(*d*)
Asbestos	tons	10	2,150	18	3,000
Brick (sand-lime)	M	9,079	87,159	71	37,110
" (fancy and pressed)	"	36,233	474,614	407	206,844
" (common)	"	68,214	713,824	909	473,375
Tile (drain)	"	15,940	546,040		
" (building)	"	3,933	301,688		
Cement (Portland)	bbls.	2,063,231	2,934,271	589	538,355
Corundum	tons	188	31,213	46	33,817
Feldspar	"	18,334	81,802	136	67,182
Fluorspar	"	4,327	66,474	56	29,582
Graphite (refined)	"	3,173	296,587	156	120,053
Gypsum (crushed, ground and calcined)	"	48,943	130,138	70	59,966
Iron pyrites	"	286,049	1,111,264	580	583,819
Lime	bush.	2,820,507	657,364	325	262,132
Mica	tons	435	92,453	88	48,490
Natural gas	M. cu. ft.	20,026,000	3,220,123	783	537,946
Petroleum (crude)	Imp. gals.	7,104,700	475,000	(*e*) 79	(*e*) 75,670
Pottery			94,501	41	35,318
Quartz	tons	176,993	358,674	217	165,032
Salt	"	138,909	1,047,707	312	234,925
Sand and gravel	cu. yds.	1,187,973	431,597	417	232,971
Sewer pipe			378,923	202	168,421
Stone, (building, granite, trap, etc.)			939,052	652	475,794
Talc (crude and ground)	tons	16,076	179,554	56	49,734
Total non-metallic			15,261,975	6,210	4,439,536
Add metallic			56,831,857	13,180	17,832,952
Grand total			72,093,832	19,390	22,272,488

(*a*) Copper valued at 18½ and nickel at 25 cents per pound in the matte.

(*b*) Total production of iron ore 176,833 tons.

(*c*) Production from Ontario iron ore only. Total pig iron production 691,233 tons, value $14,201,695.

(*d*) Included with cobalt and nickel compounds.

(*e*) Employees and wages for proportion of domestic crude petroleum distilled in Ontario oil refineries.

Table II gives for the last five years the value of the production of the various metals, minerals, and mineral products. The figures show that the metallic output has increased in value during the period by 51 per cent., while the non-metallic production in 1917 was a little less in value than in 1913. The latter fact is due to the very heavy falling off in the manufacture of construction materials which followed the outbreak of the war. There are symptoms that this depression of the building and allied trades is beginning to be lifted, and in the meantime the expansion of other branches of non-metallic mining has practically made good the loss.

TABLE II.—VALUE OF MINERAL PRODUCTION, 1913 TO 1917.

Product.	1913	1914	1915	1916	1917
METALLIC:	$	$	$	$	$
Gold	4,558,518	5,529,767	8,501,391	10,339,259	8,698,735
Silver	16,579,094	12,795,214	12,174,312	12,703,591	16,183,208
Cobalt	420,386	546,479	(a) 379,657	(a) 762,327	(a) 1,122,779
Copper	1,840,492	2,081,332	3,926,018	8,365,255	7,961,662
Nickel	5,250,803	5,136,804	(b)17,042,230	(b)20,685,564	(b)21,041,956
Other Nickel and Cobalt compounds	.....	45,189	9,227	60,956	42,026
Iron ore (exported)	138,750	169,427	171,345	342,700	483,690
Pig iron	8,719,892	7,041,079	(c) 1,891,400	(c) 1,646,010	(c) 1,016,699
Lead (pig)	.....	.....	.....	70,863	172,601
Molybdenite	.....	.....	14,099	26,393	108,561
Metallic production	37,507,935	33,345,291	44,109,679	55,002,918	56,831,857
NON-METALLIC:					
Actinolite	.....	.....	.....	.....	1,320
Arsenic	64,146	116,624	148,379	200,103	608,483
Asbestos	.....	.....	.....	100	2,150
Brick, common and sand-lime	3,452,352	2,336,207	763,591	569,559	800,983
Brick, paving, fancy, etc.	243,119	237,440	158,515	318,942	474,614
" pressed	919,741	656,944	217,350		
Calcium carbide	123,100	142,883	(d)	(d)	(d) .....
Cement, Portland	4,105,455	2,931,190	2,534,537	2,242,433	2,934,271
Corundum	137,036	65,730	31,398	8,763	31,213
Feldspar	67,142	55,686	47,031	42,159	81,802
Fluorspar	.....	.....	.....	10,146	66,474
Graphite	93,054	87,167	115,274	249,586	296,587
Gypsum	92,627	221,175	190,422	116,206	130,138
Iron pyrites	171,687	264,722	353,498	471,807	1,111,264
Lime	390,600	333,407	244,953	265,356	657,364
Mica	55,264	40,402	33,490	55,407	92,453
Natural gas	2,362,021	2,346,687	2,622,838	2,404,499	3,220,123
Peat fuel	1,750	2,100	.....	.....	.....
Petroleum (crude)	398,051	337,867	300,219	387,846	475,000
Phosphate of lime	.....	3,150	.....	.....	.....
Pottery	52,875	25,720	49,387	87,025	94,501
Quartz	130,860	82,544	142,354	223,514	358,674
Salt	474,372	498,383	585,022	700,515	1,047,707
Sand and gravel	233,567	151,909	178,288	470,963	431,597
Sewer pipe	600,297	571,756	361,283	216,749	378,923
Stone, building, crushed, etc.	1,137,153	1,088,862	651,593	755,313	939,052
Talc, crude and ground	125,340	74,583	85,325	111,489	179,554
Tile, drain	292,767	277,530	321,253	275,471	546,040
" building	.....	.....	..... (e)	176,953	(e) 301,688
Non-metallic production	15,724,376	12,950,668	10,136,000	10,300,904	15,261,975
Add metallic production	37,507,935	33,345,291	44,109,679	55,002,918	56,831,857
Total production	53,232,311	46,295,959	54,245,679	65,303,822	72,093,832

(a) Cobalt oxide and metallic Cobalt.
(b) Nickel in matte, oxide and metallic Nickel.
(c) The product of Ontario ore only.
(d) Raw materials not all produced in Ontario.
(e) Included in former years with fancy and paving Brick.

The steady growth of the mineral industry of the Province is seen by comparing the value of the production by five-year periods since 1891, the date at which the Bureau of Mines was brought into existence. Following are the figures:—

Year.	Value Production. $	Growth per cent.
1891	4,705,673	
1896	5,235,003	11.2
1901	11,831,086	125.9
1906	22,388,383	89.2
1911	41,976,797	87.4
1916	65,303,822	55.5

As the figures show, the growth was continued into 1917, the total production being worth $72,093,832, or 10.3 per cent. above that of 1916.

Table III shows the value of the various metals and metal-bearing substances produced in Ontario from the time mining began down to the end of 1917. As will be noted, silver holds the first place, followed by nickel, pig iron, gold and copper, in the order given. Owing to a change in the method of compiling these statistics, pig iron since 1914 comprises only the pig product of Ontario ore smelted in the Province, and iron ore only ore exported. Including all pig iron produced in the Province regardless of the place of origin of the ore, and in iron ore all the domestic ore mined, whether smelted here or exported, the totals for pig iron and iron ore respectively would be $102,859,096 and $9,869,864.

TABLE III.—TOTAL PRODUCTION OF METALS IN ONTARIO.

Metal.	To end of 1916.	1917	Total Production.
	$	$	$
Gold	33,663,648	8,698,735	42,362,383
Silver	151,428,500	16,183,208	167,611,708
Platinum and Palladium (*a*)	290,755	.....	290,755
Cobalt (*b*)	3,180,990	1,122,779	4,303,769
Nickel (*c*)	89,128,164	21,041,956	110,170,120
Other Cobalt and Nickel Compounds	115,372	42,026	157,398
Copper	33,452,628	7,961,662	41,414,290
Iron Ore (*d*)	8,193,881	483,690	8,677,571
Pig iron (*e*)	76,544,482	1,016,699	77,561,181
Lead	188,153	172,601	360,754
Zinc	92,410	.....	92,410
Molybdenum	42,167	108,501	150,668
Total	396,321,150	56,831,857	453,153,007

(*a*) Figures incomplete.
(*b*) Includes metallic contents of Cobalt oxide.
(*c*) Includes metallic contents of Nickel oxide.
(*d*) From and including 1915 only ore exported.
(*e*) From and including 1915 only product of domestic ore.

The War and the Mineral Industry

The influence of the war on the mineral industry of the Province was discussed in the last Report of the Bureau, and it will now suffice to say that the effects there mentioned are still in evidence, and are in some directions becoming even more marked. For instance, the margin between profit and loss in gold mining is growing narrower, and in some properties has disappeared altogether. The high cost of labour, the difficulty of obtaining it in sufficient quantity and of the proper quality, and the steadily increasing prices of supplies, have united in raising the cost of production to a point where self-interest suggests that it would be better to suspend operations until more normal conditions return. In mines of lower grade, considerations of this kind have become very urgent, and some of the owners have felt impelled to close. They have not seen the wisdom of continuing to operate at a loss, and have decided that the prudent course is to leave the ore in the mine in the hope of being able to extract it at a profit some time in the future. How far this process will extend, it is impossible to say. So long as gold remains the basis of our monetary system, so long will it be essential to maintain a sufficient supply, and in sacrificing some part of their profits in remaining in operation, those companies which do so are acting a patriotic part.

In another and quite different direction, the war is telling against the mining industry. Assiduous and intelligent prospecting for new mineral areas and ore bodies is essential to the maintenance, not to say the progress, of mining. Now, very many of the best and most capable prospectors have gone overseas to fight the King's enemies, and their absence is being felt. Gold and silver mines are not like farms, and cannot be worked for ever, or even for many years. There must be a constant succession of new properties to take the place of those being exhausted, otherwise the industry will languish. The pre-Cambrian formations of northern Ontario have already given such proof of their mineral riches that there can be no doubt many valuable metal deposits remain undiscovered. It is to be hoped that when the victory for freedom and civilization has finally been won, many of the gallant men who laid down the prospector's pick for the rifle will return to their native heath and once more fare forth into the wilderness to find the treasures which it hides.

On the other hand, the demands of the war have greatly stimulated the production of certain minerals, and practically given rise to new mining industries. An essential in the manufacture of explosives, as, in fact, of chemicals of almost any kind, is sulphuric acid. Since the stoppage of supplies of free sulphur from Sicily, the product of Louisiana and Texas has not been sufficient for the tremendous demand for sulphuric acid from the munition plants of the United States, and the lack is being in large part supplied by the importation of iron pyrites from Ontario. The principal producer is the Nichols Chemical Company, Limited, whose mines are at Northpines and Goudreau, north of Lake Superior; also at Sulphide, in the county of Hastings, where it operates an acid plant. The production of pyrite rose from 145,315 tons in 1916 to 175,593 tons in 1917, most of which was exported to the United States. It is expected that about one-third of the total requirements of pyrite in the U.S. for 1917, or, say 400,000 tons, will be obtained in Ontario.

Another mineral which has sprung suddenly into active demand is fluorspar, which is used as a flux in steel-making. There are a number of deposits near

Madoc, in Hastings county, and as the price has risen from $4 or $5 to about $30 per ton, strenuous efforts are being made to meet the demand, and a considerable proportion of the known deposits have been opened and are being worked.

Molybdenite, to take the place of tungsten in the manufacture of special steels for tool-making and other purposes, has also come into prominence during the past four years. A number of molybdenite showings have been developed and a considerable quantity of concentrates produced. Ferro-molybdenum has also been made at Orillia and Belleville in the electric furnace. An account by A. L. Parsons was given in the Bureau's last Report of the principal occurrences of molybdenite in the Province.

Nickel and copper are, of course, prime requisites in modern warfare, and the capabilities of the Sudbury mines were taxed during the past year to supply the demand. Production had reached its maximum in 1916, and the output last year was practically on the same level, being 41,887 tons of nickel and 21,197 tons of copper in the matte, as against 41,299 tons of nickel and 22,430 tons of copper in 1916.

The conditions under which the mining industry is at present being carried on are perhaps more difficult than at any previous time. The extreme scarcity of labour caused by the withdrawal of so large a proportion of working miners and labourers continues to hamper operations, and there is little relief in sight except what may result from the slackening of operations in the gold fields. The bulk of the labour actually employed in mining is of foreign origin, not a little of it indeed alien enemy in character. It does not appear that any large proportion of this enemy labour is actively hostile, but the presence in our mines and mills of so many workmen who, technically at least, are the enemies of our country, cannot be regarded as a satisfactory feature. The mining industry is essential to the carrying on of the war, since it provides the raw materials for weapons and munitions, and the metals required for financing the struggle. No doubt a recognition of this fact reconciles a good many people to a spectacle which would otherwise be intolerable—that of enemy workmen employed at large wages while patriotic Canadians are risking their limbs and lives at very much smaller pay.

It will be remembered that in May, 1917, on account of the dearth of labour, and to enable prospectors and claim-holders to remain at work in the mines, an Order-in-Council was passed permitting the postponement of assessment work on mining claims for twelve months. The provisions of this order were largely taken advantage of, and the result was that in 1918 two instalments of assessment work fell due on many claims, namely, the instalment for 1917 and also that for 1918. To ease the situation, in June, 1918, another Order was passed declaring it unnecessary in such cases to do more than the work postponed from last year, and also moving forward for twelve months the period for performing any subsequent instalment or instalments of work.

The high and steadily mounting cost of supplies of all kinds, and the delays attendant upon the procuring of machinery, are also embarrassing the mining industry in common with others. The peremptory and enormous demands of the war for steel and iron must first of all be met, and only what remains can be diverted to peaceful industries. While so large a proportion of the manufacturing plants both of Canada and the United States are engaged in making munitions of war, this difficulty of obtaining mining machinery and plant will necessarily

continue. Coal is also required at many mining properties for heating and at some for power, and the coal situation is certainly not all that could be desired. However, electric energy generated hydraulically is now so generally used for the operation of mines and works in Ontario that the scarcity of fuel is not so serious in mining as in many other industries.

The operation of the taxation laws, Dominion and Provincial, has not borne with undue harshness upon mining. In both cases profits are the basis of the tax, and if no profits are realized no taxation is imposed. In addition, the Dominion taxing regulations permit allowance to be made for exhaustion of the mine, which materially reduces the amount of the tax. Except in the case of nickel-copper mines, and also where profits exceed one million dollars per annum, the Ontario tax remains at 3 per cent. of the net profits. The Canadian Copper Company contested the constitutionality of the amendments of 1917 to the Mining Tax Act of Ontario, and applied to the Government of Canada to disallow it. Argument was heard by the Government in the matter, but it declined to interfere.

Gold

The production for 1917 was 420,893 fine ounces, being 76,940 ounces or about 15 per cent. less than in 1916. The causes of this decrease have already been mentioned, the principal, if not the only one, being the greatly increased cost of production of an article whose price is fixed. All but about 6 per cent. of the gold was obtained from the mines of Porcupine. Here the leading producer was the Hollinger, followed by the McIntyre, Dome, Porcupine Crown, Porcupine V.N.T., and Schumacher, in the order named. Dome Lake made a small production, and there was a little gold obtained at one or two other prospects under development. At Kirkland Lake, Tough-Oakes was joined during the year as a producer by Teck-Hughes. The only other productive property of account was the Crœsus, which won some 2,837 ounces of gold from 1,541 tons of ore. In Table IV, given below, will be found particulars of the gold production for 1917:—

TABLE IV.—GOLD MINING IN 1917.

Mine.	Tons Ore milled.	Gold Product.		Silver Product.		Total Value.	Extraction per ton	Dividends in year.
		Fine ounces.	Value.	Fine ounces.	Value.			
			$		$	$	$ c.	$ c.
Porcupine—								
1. Dome	359,570	71,193	1,471,705	10,659	8,169	1,480,174	4 12	300,000 00
2. Dome Lake	16,388	2,166	44,791	176	143	44,434	2 61	
3. Hollinger	514,301	204,810	4,233,777	31,886	28,161	4,261,938	8 29	738,000 00
4. McIntyre	175,893	81,827	1,690,126	17,536	14,078	1,710,204	9 73	541,542 15
5. Newray	340	70	1,440	9	7	1,447	4 26	
6. Porc. Crown	39,111	18,180	375,766	2,637	2,138	377,904	9 66	120,000 00
7. " V.N.T.	34,971	10,416	208,350	1,705	1,388	209,738	5 99	
8. Schumacher	37,323	9,551	197,413	1,191	1,192	198,605	5 32	
9. Tommy Burns & Gold Reef	31	11	876	1	1	877		
Kirkland Lake—								
10. Teck-Hughes	11,957	3,181	65,753	1,155	969	66,722	5 41	
11. Tough-Oakes	38,695	16,381	338,593	5,257	4,237	342,830	8 86	
Miscellaneous—								
12. Cordova	860	29	593			593	(a)	
13. Crœsus	1,541	2,837	59,820	281	226	60,046	38 97	
14. Rognon	40	14	279			279	6 97	
15. St. Anthony		94	1,944	26	23	1,967		
16. Small Producers	3	43	884	101	242	1,126	5 89	
17. Copper Ore		54	1,125			1,125		
Total	1,230,324	420,893	8,698,735	76,223	61,274	8,760,009	7 12(b)	1,699,542 15

(a) Over $3,000 in gold lost in fire.
(b) Average of 1 to 16 inclusive, omitting Nos. 12 and 15.

Development work is going on in several of the newer gold areas, and the prospect is that ere long some of these properties will contribute to the output of gold. At Boston Creek, the Patricia syndicate took over the Boston-Hollinger claim in August 1917, and by the end of the year had power plant installed and the necessary buildings erected. Two shafts had been sunk, 110 and 90 feet respectively in depth, and it was proposed to erect a 40-stamp mill. In this camp also the Miller Independence Mines, Limited, installed a standard Ball mill, with amalgamation and oil-flotation treatment of concentrates.

At Kirkland Lake there was a good deal of activity. Lake Shore Mines, Limited, built a mill of approximately 60 tons per day capacity, and expected to have it in operation in March, 1918. It is of the ball-and-tube grinding type, with continuous counter-current decantation process for gold recovery. Kirkland Lake Gold Mining Company, Limited, also had a gold mill in course of construction. The Wright-Hargreaves Mines, Limited, continued sinking and developing operations, employing a force of about 50 men.

The mill at the Dome mine, Porcupine, operated for most of the year, but closed down at the end of November, the cost of production having risen to a point where operations were unprofitable. Underground work, however, was continued.

The Canadian Exploration Company, at Long Lake, did some diamond-drilling in the early part of the year, and a little experimental work on tailings, but later closed the mine entirely.

Following is a list of the producing gold mines, with the post-office address of the manager, etc.:—

PRODUCING GOLD MINES, 1917.

Name of Company.	Name of Mine.	Locality.	P.O. Address of Manager, etc.
Cordova Mines, Limited	Cordova	Eastern Ontario.	Toronto.
Crœsus Gold Mines, Limited	Crœsus	Munro tp.	Matheson.
Crown-Newray Company	Newray	Porcupine	Timmins.
Dome Mines Co., Limited	Dome	Porcupine	
Dome Lake Mining and Milling Company, Limited	Dome Lake	Porcupine	South Porcupine.
Hollinger Consolidated Gold Mines, Limited	Hollinger	Porcupine	Timmins.
McIntyre-Porcupine Mines, Limited	McIntyre	Porcupine	Schumacher.
Porcupine Crown Mines, Limited	Porcupine Crown	Porcupine	Timmins.
Porcupine V. N. T. Gold Mines, Limited	Vipond-North Thompson	Porcupine	Timmins.
Rognon Gold Mines, Limited	Rognon	Wabigoon Lake	Dryden.
Schumacher Gold Mines, Limited	Schumacher	Porcupine	Schumacher.
Teck-Hughes Gold Mines, Limited	Teck-Hughes	Kirkland Lake	Kirkland Lake.
Thunder Mining Company, Limited	St. Anthony	Sturgeon Lake	St. Anthony Mine.
Tough-Oakes Gold Mines, Limited	Tough-Oakes	Kirkland Lake	Kirkland Lake.

The gold production of the Province and of the Porcupine area respectively, for the last seven years, are given in the table appended. As the figures show, the Porcupine mines have supplied very much the larger share of the total.

GOLD PRODUCTION, 1910-1917.

Year.	Total Production. $	Porcupine. $	Percentage from Porcupine.
1910	68,498	35,539	51.8
1911	42,637	15,437	36.2
1912	2,114,086	1,730,628	81.8
1913	4,558,518	4,294,113	94.1
1914	5,529,767	5,190,794	93.8
1915	8,501,391	7,536,275	88.6
1916	10,339,259	9,397,536	90.8
1917	8,698,735	8,229,744	94.5

On a later page will be found Table V. which shows the dividends which have been declared by the gold mining companies in Ontario up to the end of 1917. It will be seen that for last year the amount so declared was $1,699,542.45, and for the full period, $11,486,167.45.

The Case of the Gold Mining Industry

For the immediate future the outlook is for a diminution of the gold yield of the Province, but this by no means reflects upon the capability of the producing areas, new or old. It is simply the result of economic conditions, a suspension, not a cessation, of activity, and at the worst only partial. In the long run the expenditure of money in operating an unprofitable enterprise must result in lessening the stock of capital employed in the industry, and from this point of view is economically unsound.

But there is little room to doubt that with the return of peace there will come a renewal of vigorous life in the gold mining camps of the North. The colossal expenditures of the belligerent nations during the period of the war have far outstripped the ability of the gold reserves of the world to finance them, measured by any customary pre-war basis. These reserves have been computed roughly to amount to $10,500,000,000, or, say, 17,000 tons of gold. Practically all the combatant nations, Italy excepted, have a single standard for their financial basis, namely, gold. Hence the debts which all have so lavishly contracted, and are still contracting, are nominally payable in this metal. But the entire gold reserves of the world, instead of representing about 35 per cent. of the total indebtedness of the warring nations, as they did before the beginning of the conflict, now amount to only about 8 per cent. Consequently, the ability of any nation to obtain funds for war expenditures now depends much less than formerly upon the amount of gold which it possesses or controls, and rests in fact almost wholly on its credit. This in turn is based upon its previous financial record, and its present and potential resources. Yet all the borrowings, and the interest annually accruing upon them, are payable in gold, and hence the necessity imposed upon the borrowers to provide themselves with this essential metal. As gold is the article in demand, among the most important assets of a nation is its gold fields, and it is reassuring to remember that Great Britain and her Allies control over 90 per cent. of the world's gold production. The gold mines of the British Empire alone annually provide about 62 per cent. of the entire yield, which in 1917 is estimated at about £96,700,000.

The favourable trade position occupied by the United States after the war began and up to the time when she too was constrained to throw her sword into the

scale, enabled her to increase her share of the world's monetary stock from about one-fifth to nearly one-third; the coin and bullion used as money in that country on November 1, 1917, being estimated at $3,041,500,000. As a matter of practical experience neither the world stock of gold or of silver, nor both combined, has proven sufficient to meet the necessities of trade and finance occasioned by the war, and the strain upon these metals has had in every country to be relieved by the issue of paper currency. One of the first war acts of the British Government was to print, in August, 1914, one-pound and ten-shilling notes, nothing of smaller denomination than the five-pound notes of the Bank of England having previously been in circulation in England.

Unless the changes which everyone is predicting are to follow the war, include the overthrow of our present systems of exchange and the substitution of some other basis for that of gold, the demand for that metal will continue, and will probably become greater than ever. Should the cost of labour and supplies fail to drop to a level at which low grade mines again become profitable, the nations may have to face the question whether, on the ground of public necessity, they should not come actively to the aid of the gold mining industry.

Silver

There was a slight falling off in the quantity of silver mined and marketed last year as compared with 1916, the quantities respectively being 19,479,692 and 20,007,367 fine ounces, a decrease of 2.6 per cent. In value, however, there was a large increase. In 1916 the return to the mining companies was $12,703,591, while in 1917 it was $16,183,208, or 27.3 per cent. more. Thus, while in 1916 the average price per fine ounce received by the mine owners was 63.19 cents, last year it was 83.07 cents. For the entire year 1917 the average price for silver in New York was 81.417 cents, as compared with 65.661 cents in 1916. The lowest monthly average price was 73.861 cents in March, and the highest 100.740 cents in September. On September 21 the price rose to $1.08 per ounce, and on September 28 the Mining Corporation of Canada is stated to have sold 200,000 ounces of silver on a basis to net the company in Toronto $1.16 7-16 per ounce. On the same day the New York price was $1.085 per ounce. These are the highest figures for silver that have been quoted for forty years. The price in London on September 21 rose to 55d. standard, the highest figure since March, 1878. It remained four days at this point, and then began to fall in a spectacular fashion, until October 23, when it reached 41⅞d., a drop of 13⅛d. in less than a month. On October 30 a rise of 3d. occurred from 43d. to 46d., the largest variation in a single day on record. Since the close of the year the United States Government has decided to melt into bullion as much as is necessary of some $400,000,000 it holds in silver dollars, and to fix the price for purchase of silver to replace them at $1.00[1] per fine ounce, thus ensuring a firm and high market for the output of the Cobalt mines.

The rapid rise in the value of silver last year was in the main due to the demand for coinage purposes by the belligerent nations, including China. The European armies are paid in silver, and huge disbursements are constantly being made to the millions of men under arms.

[1] Since increased to $1.01½.

Influence of the East

The Chinese demand arose from an effort by that country in the latter part of the summer to replace part of its currency, of which large amounts had earlier in the year been shipped abroad, chiefly to India which imported from China some 39 million ounces. China's policy of alternate buying and selling silver was largely responsible for the rapid fluctuations of price during the year. The monetary system of that country, if system it can be called, being based on silver, the rise in price of that metal greatly helped the revenue of the Chinese Government, especially in relation to payments of foreign indebtedness which had to be made in gold. In China gold is a commodity, just as silver is in other countries, and the enhanced value of silver led to an increased purchase of gold in the form of objects of art and jewellery. A large part of the imports of silver, amounting to 25 millions of ounces, came from San Francisco; London, for the time at any rate, being unable to compete with Western ports on account of the greater cost of carrying silver across the Atlantic owing to the high rates of insurance against war risk. This considerable diversion of silver from the London market contributed largely to the remarkable rise in price to 55d. per standard ounce in September.

The increased cost of commodities, which was as marked in the East as in the West, the large war expenditures and consequent stimulation of business demanded an increase in the amount of currency, and accordingly the Indian mints became very busy. During the twelve months ending March 31, 1917, the coinage of rupees,[1] half-rupees and quarter-rupees amounted to 307¾ million rupees, the equivalent of nearly 106 million fine ounces of silver. The net imports into India during this period were a little less than the silver coined, or 104,069,101 ounces, but the Government

[1] The rupee is the standard measure of value in India, and it also circulates largely in Mesopotamia, Egypt, etc. It is a silver coin weighing 180 grains, of which 165 parts are pure silver and 15 parts alloy. There are 16 annas in a rupee, and one anna equals 12 pies (or pice); 8-anna and 4-anna pieces are struck in silver, 1-anna pieces in nickel, ¼-anna, ⅛-anna and 1-12-anna pieces in bronze. The value of a rupee is one-fifteenth part of one pound sterling, or 1s. 4d., hence one anna is the equivalent of a penny. The gold standard was introduced into India in 1899, but as yet no sovereigns have been minted there. A lac (or lakh) is 10,000 rupees, and a crore is 10,000,000 rupees.

The extreme poverty of the majority of the Indian people is illustrated by an example from life given in Benjamin White's "Silver, its History and Romance" (Hodder and Stoughton, London, New York and Toronto, 1917). An agricultural labourer's family in Bengal consisted of himself (aged 18), two younger brothers aged 8 and 6 years respectively, a sister of eleven, and his wife and mother, six persons in all. The head of the household and his 8-year old brother were the breadwinners, earning 2d. per day each, the wages being paid sometimes in cash, but generally in kind. The family possessions consisted of 3 cows, value £4 10s., and some goats; their furniture of three brass dishes, a few kitchen utensils and a grindstone (flour mill), total 8s. The entire expenditure of this family for one year was £6 sterling, of which £4 15s. went for food, 15s. for clothing, and 10s. for other purposes, including 8d. for celebration of the sun-god festival. It is evident that among the 300,000,000 people whose standard of living sinks to so low a level, coins of small denomination are required in the myriad transactions of daily life, hence the circulating media are largely confined to the rupee and smaller coins. Since the war began, however, even the Hindu labourer's wages have materially increased.

In explanation of the almost uninterrupted disappearance from view of much of the silver imported into India, Mr. White says: "The Indian native is a born hoarder. Generation after generation of unrest has passed in India. Great empires in succession have risen and fallen, and the coming and going of each ruling power has been bad for the peasant. So, throughout the ages, he sank his little pile in mother earth, to be disinterred in another and perhaps happier time. 'Will the British Raj last any more than the others?' he says. 'It is true we are not ground and taxed to death as in the past; so much the better for our underground reserves.' For this operation nowadays, he prefers to secrete a portion in gold. He can better afford it; it is handier for hoarding, and it is less bulky for carrying."

was able to procure an additional £1,000,000 worth in the local bazaars. The exceptional promise of good crops in India in 1917, which promise was fulfilled, required the mints to remain at work, and coinage to the extent of 207,737,326 rupees was turned out during the year. For the six months ending September 30, 1917, the net imports into India were 42,915,610 ounces. The internal demand for silver in India for use in the arts, usually large, became very great, and to a considerable extent was met by "country bars," *i.e.*, bars made by melting down old stocks of jewellery, etc. The existing high prices tempted many people who had bought their silver jewellery in the years when prices were very much lower, to realize a profit by re-selling it as bullion. Later in 1917 the export of silver from India was prohibited, and imports were regulated by providing that none should be brought in except under license. To supplement the very large coinage of silver, the Indian Government decided upon an issue of rupee notes, thus falling in line with many of the Western nations. The prohibition by the British Government of shipments of gold to India, with the view of reducing the drafts on the all-important stocks of that metal held in England necessitated settlement of the balance of trade in favour of India to be made in silver, and this fact, together with a somewhat similar situation in China and Japan has no doubt assisted in maintaining the high level to which the price of silver has risen. The action of the United States Government in resolving to melt into bullion $400,000,000 worth of silver dollars held in reserve against silver certificates, and to place the bars upon the market as required, was very opportune in relieving the strain thrown upon the financial functions of silver in the East, where perhaps 75 per cent. of the production of the world is annually consumed.

In Europe and America, the principal feature of the silver industry was the purchase by Great Britain, France, and the United States of large quantities to be coined for payment of their troops. The continent of America being the source of over 80 per cent. of the silver annually produced in the world, and the continent of Asia absorbing over two-thirds of it, it would seem that the direct route from the Pacific coast to China and India would even in normal times offer advantages over Atlantic shipments with transfer at London. Insurance rates were high during 1917, and much more silver than usual was exported from San Francisco and Vancouver. The currents of trade once firmly established are, however, very persistent, and the control that London exercises over Eastern exchange will probably be strong enough to ensure a restoration of former conditions when peace returns.

Silver Largely a By-Product

The events which in any quarter of the world have a bearing upon the demand and price for silver, have a special interest for that branch of the mining industry in Ontario, by reason of the fact that the mines of this Province are among the comparatively few which are worked primarily for their silver contents. Probably two-thirds of the silver production of the world is obtained as a by-product of lead, copper, and zinc mines, in the ores of which silver is present in quantity worth saving, yet not usually sufficient to warrant their being worked for the silver alone. The lead, copper, or zinc would continue to be produced if the market price of the metal or metals warranted, whether silver were high in price or low,

and fluctuations in the price of the by-product metal are of comparatively little significance. In the case of Cobalt, however, silver is the paramount product, and consequently the ruling price of silver is the fact of prime importance. Because of silver being in this sense subsidiary to other metals, even a decided advance in value, such as occurred in 1917, has not the effect of increasing the output to the same extent as if it were in the main worked for its own sake only. Hence it is unlikely that the present value of silver will be reduced by a sudden and large increase of the world's output, and so long as the present urgent demand continues, it may reasonably be expected that the price will remain high.

The production of silver in the world last year is estimated at about 167,000,000 fine ounces. Of this, the United States contributed 74,244,500 ounces, and Canada 22,150,680 ounces. Mexico, which a few years ago led all the countries with a yield of over 70,000,000 ounces, has now fallen to about half that quantity, and the policy of hostility towards foreign capital invested in mining being pursued by the Government in power renders it unlikely that her former position will be soon resumed.

The production of silver in the Province last year, according to camps, was as follows:—

	Ounces.
South Lorrain	10,000
Gowganda	1,064,635
Cobalt proper	18,327,258
Silver recovered from gold and copper ores	77,799
Total	19,479,692

The mines sending out more than one million ounces of silver were:—

	Ounces.
Mining Corporation	4,546,065
Nipissing	3,794,242
Kerr Lake	2,302,466
Coniagas	1,273,853
O'Brien	1,064,335
Miller-Lake O'Brien	1,050,149
McKinley-Darragh-Savage	1,013,602

Those shipping less than a million ounces, but more than a quarter of a million were:—

	Ounces.
Temiskaming	887,122
Buffalo	645,915
La Rose Consolidated	478,639
Beaver Consolidated	462,723
Chambers-Ferland	330,063
Trethewey	311,324
Crown Reserve	309,420
Hudson Bay	277,091
Penn-Canadian	259,784

Silver and Gold Dividends

Table VII, which is appended, gives a list of the silver and gold mining companies which have paid dividends, and shows the amounts so paid, etc. In 1917 the distribution of dividends and bonuses amounted to $5,586,946.80, and in the entire period to $70,821,829.34.

TABLE V.—DIVIDENDS AND BONUSES BY GOLD AND SILVER MINING COMPANIES TO DECEMBER 31, 1917.

Name of Company.	Date of Incorporation.	Authorized Capital.	Capital Stock Issued.	Par value per share.	Amount of Dividends and Bonuses paid to end of 1916	Amount of Dividends and Bonuses paid during 1917.		Total of Dividends and Bonuses paid to Dec. 31st, 1917.	Last Dividend or Bonus. Date declared.
GOLD COMPANIES.		$	$	$ c.	$	$ c.	%	$	
Dome Mines Company, Ltd.	Mar. 23, 1910	5,000,000	4,000,000	10 00	1,200,000 00	300,000 00	7½	1,500,000 00	May 7, 1917
*Hollinger Consolidated Gold Mines, Ltd.	May 20, 1916	25,000,000	24,600,000	5 00	7,456,000 00	738,000 00	3	8,194,000 00	April 22, 1917
McIntyre-Porcupine Mines, Ltd.	Mar. 16, 1911	4,000,000	3,610,283	1 00	.....	541,542 45	15	541,542 45	Sept. 29, 1917
Porcupine Crown Mines, Ltd.	May 26, 1913	2,000,000	2,000,000	1 00	720,000 00	20,000 00	12	840,000 00	July 15, 1917
Rea Consolidated Gold Mines	April 5, 1911	1,000,000	200,000	5 00	12,000 00	.....	....	12,000 00	.....
Tough-Oakes Gold Mines, Ltd.	July 15, 1913	3,000,000	2,657,500	5 00	398,625 00	.....	....	398,625 00	Dec. 27, 1916
Total by Gold Companies					9,786,625 00	1,699,542 45	....	11,486,167 45	
SILVER COMPANIES.									
Aladdin Cobalt Company, Limited	Aug. 23, 1912	500,000	500,000	5 00	.....	75,000 00	15	75,000 00	April 30, 1917
Beaver Consolidated Mines, Ltd.	Mar. 1, 1907	2,000,000	2,000,000	1 00	650,000 00	.....	....	650,000 00	April 8, 1916
Buffalo Mines, Ltd., The	April 27, 1906	1,000,000	1,000,000	1 00	2,787,000 00	.....	....	2,787,000 00	May 28, 1914
Casey Cobalt Silver Mining Company, Ltd.	Dec. 19, 1906	100,000	100,000	1 00	203,249 33	.....	....	203,249 33	April 22, 1914
Cobalt Comet Mines, Ltd.	April 16, 1913	1,000,000	1,000,000	1 00	230,000 00	.....	....	230,000 00	April 1, 1915
Coniagas Mines, Limited, The	Nov. 24, 1906	4,000,000	4,000,000	5 00	8,440,000 00	300,000 00	7½	8,740,000 00	Aug. 8, 1917
Crown Reserve Mining Co., Ltd.	Jan. 16, 1907	2,000,000	1,999,957	1 60	6,190,849 00	.....	....	6,190,849 00	Dec. 28, 1916
Kerr Lake Mining Company, Ltd.	Aug. 9, 1905	40,000	40,000	100 00	7,128,000 00	662,000 00	....	7,790,000 00	Oct. 9, 1917
La Rose Mines, Ltd.	May 31, 1908	6,000,000	6,000,000	5 00	6,030,546 84	240,000 00	4	6,270,546 84	Sept. 11, 1917
McKinley-Darragh-Savage Mines of Cobalt Ltd.	April 17, 1906	2,500,000	2,247,692	1 00	4,943,930 46	269,723 04	12	5,213,653 50	Nov. 6, 1917
†Mining Corporation of Canada, Ltd.	Mar. 20, 1914	2,075,000	2,075,000	1 00	1,348,750 00	1,556,296 86	18¾	2,905,046 86	Dec. 15, 1917
Nipissing Mining Company, Ltd.	Dec. 16, 1904	250,000	250,000	100 00	16,288,297 25	1,935,000 00	....	18,233,297 25	Dec. 6, 1917
Penn-Canadian Mines, Ltd.	April 24, 1912	1,500,000	1,349,705	1 00	67,485 25	148,467 55	11	215,952 80	Sept. 10, 1917
Peterson Lake Silver-Cobalt Mining Co. Ltd.	April 11, 1906	3,000,000	2,401,820	1 00	420,031 50	42,031 85	1¾	462,063 35	Jan. 2, 1917
Seneca-Superior Silver Mines, Ltd.	Sept. 29, 1911	500,000	478,884	1 00	1,579,817 20	.....	....	1,579,817 20	Dec. 15, 1916
Temiskaming Mining Co., Ltd.	Nov. 5, 906	2,500,000	2,500,000	1 00	1,684,156 25	300,000 00	12	1,984,156 25	Oct. 5, 1917
Wettlaufer Lorrain Silver Mines, Ltd.	Nov. 30, 1908	1,500,000	1,416,590	1 00	637,465 50	.....	....	637,465 50	Sept. 22, 1913

Trethewey Silver Cobalt Mines, Ltd.	May 30, 1906 / June 1, 1911	2,000,000	1,000,000	1 00	1,111,998 50	50,000 00	5	1,161,998 50	Aug.	20, 1917
Right of Way Mines, Ltd.	Sept. 11, 1909	2,000,000	1,685,500	1 00	244,397 50	8,427 50	½	252,825 00	.....	.....
Right of Way Mining Co., Ltd.	July 13, 1906	500,000	500,000	1 00	324,643 93	.....	....	324,643 93	.....	.....
**City of Cobalt Mining Co., Ltd.	Oct. 5, 1906 / Jan. 7, 1909	500,000 / 1,500,000	1,500,000	1 00	145,000 00	.....	....	145,000 00	April	15, 1909
Cobalt Central Mines Co., Ltd.	Dec. 13, 1906	5,000,000	5,000,000	1 00	192,845 00	.....	....	192,845 00	Aug.	25, 1909
Cobalt Lake Mining Co., Ltd.	Dec. 22, 1906	3,000,000	3,000,000	1 00	465,000 00	.....	....	465,000 00	May	29, 1914
Cobalt Silver Queen, Ltd.	April 1, 1906	1,500,000	1,500,000	1 00	315,000 00	.....	....	315,000 00	Dec.	31, 1908
Cobalt Townsite Mining Co., Ltd.	May 8, 1906	100,000	45,011	1 00	1,042,259 61	.....	....	1,042,259 61	Nov.	11, 1914
Foster Cobalt Mining Co., Ltd.	Feb. 14, 1906	1,000,000	915,588	1 00	45,000 00	.....	....	45,000 00	Jan.	1, 1907
Temiskaming and Hudson Bay Mining Co. Ltd.	July 29, 1903	25,000	7,761	1 00	1,940,250 00	.....	....	1,940,250 00	Nov.	10, 1914
Hudson Bay Mines, Ltd.	July 16, 1909	3,500,000	3,200,050	5 00	778,909 42	.....	....	778,909 42	Aug.	31, 1913
Total by Silver Companies	.....	.....	.....	.....	65,234,882 54	5,586,946 80	....	70,821,829 34		
Total dividends	.....	.....	.....	.....	75,021,507 54	7,286,489 25	....	82,307,996 79		

* Hollinger Consolidated Gold Mines Limited is a consolidation of the Acme Gold Mines Limited, Millerton Gold Mines Limited, and Hollinger Gold Mines Limited. Dividends include $160,000 paid by the Acme prior to amalgamation with the Hollinger.

† Mining Corporation of Canada, Limited, owns and operates the City of Cobalt, Cobalt Lake and Cobalt Townsite mines.

** Now owned and operated by Mining Corporation of Canada, Limited.

Table VI, which follows, shows the shipments of ore, concentrates and silver bullion from the Cobalt silver mines since they were opened in 1904. The figures take no account of inter-camp movements, but include all shipments to outside points, whether in Ontario or the United States. The diminution in raw ores sent out, and the increase of concentrates and bullion will be noted:—

TABLE VI.—SILVER PRODUCTION, COBALT MINES, 1904 TO 1917.

Year.	No. of Producing Mines.	Shipments and Silver Contents. Ore. Tons.	Ore. Oz.	Ore. Av. per ton. Oz.	Concentrates. Tons.	Concentrates. Oz.	Concentrates. Av. per ton. Oz.	Bullion. Oz.	Total. Ounces.	Total. Value. $
1904....	4	158	206,875	1,309	.....	.....	.....	.....	206,875	111,887
1905....	16	2,144	2,451,356	1,143	.....	.....	.....	.....	2,451,356	1,360,503
1906....	17	5,335	5,401,766	1,013	.....	.....	.....	.....	5,401,766	3,667,551
1907....	28	14,788	10,023,311	677	.....	.....	.....	.....	10,023,311	6,155,391
1908....	30	24,487	18,022,480	736	1,137	1,415,395	1,244	.....	19,437,875	9,133,378
1909....	31	27,729	22 436,355	809	2,948	2,461,470	1,174	.....	25,897 825	12,461,576
1910....	41	27,437	22,581,714	821	6,845	7,082,834	1,030	980,633	30,645,181	15,478,047
1911....	34	17,278	20,318,626	1,176	9,375	8,056,180	858	3,132,976	31,507,791	15,953,847
1912....	30	10,719	15,395,504	1,436	11,214	9,768,228	871	5,080,127	30,243,859	17,408,935
1913....	35	9,861	13,668,079	1,386	11,016	8,489,321	770	7,524,575	29,681,975	16,553,981
1914....	32	4,302	6,504,753	1,511	12,152	8,915,958	733	9,742,130	25,162,841	12,765,461
1915....	24	2,865	6,758,286	2,359	11,996	10.001,548	834	7,986,700	24,746,534	12,135,816
1916....	28	2,177	4,672,500	2,146	8,561	7,598,011	887	7,644,579	19,915,090	12,643,175
1917....	28	2,288	3,271,353	1,429	13.720	6,445,243	469	8,053,318	19,401,893	16,121,013
Total ..	.....	151,568	151,712,958	1,001	88,964	71.234,197	801	50.145,038	274,724,172	151.950.561

In Table VII is shown the quantity and value of all the constituents, recoverable and recovered, in the ores of the Cobalt camp from the beginning. Until 1913 an estimate was made of the nickel, cobalt, and arsenic contents, since in few cases only were these substances paid for, and consequently no assays were made for them, but since 1914 only the actual recoveries and their money values are given. Beyond doubt in past years only a small proportion of these by-products was extracted from ore shipped to the United States, but the volume of such shipments has since been greatly reduced.

TABLE VII.—TOTAL PRODUCTION, COBALT SILVER MINES, 1904 TO 1917.

Year.	Copper.(a) on.	Copper.(a) Value.	Nickel. Tons.	Nickel. Value.	Cobalt. Tons.	Cobalt. Value.	Arsenic. Tons.	Arsenic. Value.	Silver. Ounces.	Silver. Value.	Total Value.
		$		$ c		$		$		$	$
1904..	.....	.....	14	3,460	16	19,960	72	903	206,875	111,887	136,217
1905..	.....	.....	75	10,00	118	100,000	519	2,693	2,451,356	1,360,503	1,473,196
1906..	.....	.....	169	.....	321	80,704	1,440	15,858	5,401,766	3,667,551	3,764.113
1907..	.....	.....	370	1,174	739	104,426	2,958	40,104	10,023,311	6,155,391	6,301,095
1908..	.....	.....	612	.....	1,224	111,118	3,672	40,373	19,437,875	9,133,378	9,284,869
1909..	.....	.....	766	.....	1,533	91,965	4,294	61,039	25,897,825	12,461,576	12,617,580
1910..	.....	.....	504	.....	1,098	54,699	1,897	70,709	30,645,181	15,478,047	15,603,455
1911..	.....	.....	392	.....	852	170,890	3,806	74,609	31,507,791	15,953,847	16,199,346
1912..	.....	.....	439	11,220	954	314,381	4,166	80,516	30,243,859	17,408,935	17,818,082
1913..	.....	.....	377	13,326	821	420,386	3,663	64,146	29,681,975	16,553,981	17,051,839
1914..	.....	.....	(b) 90	28,978	(b) 351	590,106	2,030	116,624	25,162,841	12,765,461	13,501,469
1915..	.....	....	(c) 35	28,353	(c) 206	383,261	2,490	148,379	24,746,534	12,135,816	12,695,809
1916..	.....	.....	(c) 79	59,380	(c) 400	805,014	2,160	200,103	19 915,090	12,643,175	13,707,672
1917..	53	28,840	(c) 155	125,071	(c) 337	1,138,190	2,592	608,483	19,401,893	16,121,013	18,028,597
Total.	53	28,840	1,058	283,969	8,950	4,388,100	38,789	1,524,569	274,721,172	151,950,561	158,176,339

(a) Copper is recovered from certain silver ores and concentrates shipped to United States refineries.
(b) Metallic contents of Nickel and Cobalt oxides respectively.
(c) Metals and metallic contents of all Nickel and Cobalt compounds.

Following is a list of the productive silver properties in operation at Cobalt in 1917:—

PRODUCING SILVER MINES IN 1917.

Company or Owner.	Mine.	P.O. Address of Manager, etc.
Adanac Silver Mines, Limited	Adanac	Haileybury.
Aladdin Cobalt Company, Limited	Chambers-Ferland	Cobalt.
Angus, D. H.	Nipissing Reduction Mill clean-up	Cobalt.
Beaver Consolidated Mines, Limited	Beaver	Cobalt.
Buffalo Mines, Limited, The	Buffalo	Cobalt.
Cobalt Comet Mines, Limited	Drummond	Giroux Lake.
Cobalt Provincial Mining Co., Limited	Provincial	Cobalt.
Cobalt Silver Queen, Ltd.	Silver Queen	Cobalt.
Coniagas Mines, Limited	Agaunico Coniagas	Cobalt.
Crown Reserve Mining Company, Limited	Crown Reserve	Cobalt.
Hargrave Silver Mines, Limited	Hargrave	Cobalt.
Hudson Bay Mines, Limited	Hudson Bay	Cobalt.
Kerr Lake Mining Company, Limited	Kerr Lake	Cobalt.
La Rose Mines, Limited	La Rose	Cobalt.
McKinley-Darragh-Savage Mines of Cobalt, Limited	McKinley-Darragh, Savage	Cobalt.
Mining Corporation of Canada, Limited, The	Cobalt Lake, Townsite-City	Cobalt.
National Mines, Limited	National	Cobalt.
Nipissing Mining Company, Limited	Nipissing	Cobalt.
O'Brien, M. J., Limited	O'Brien	Cobalt.
do	Miller-Lake O'Brien	Gowganda.
Penn-Canadian Mines, Limited	Penn-Canadian	Cobalt.
Pittsburg Lorrain Syndicate	H.R. 105, or Currie	Silver Centre.
Reeve-Dobie Mines, Limited	Reeve-Dobie	Gowganda.
Right-of-Way Mines, Limited	Right of Way	Cobalt.
Temiskaming Mining Company, Limited	Temiskaming	Cobalt.
Trethewey Silver-Cobalt Mine, Limited	Trethewey	Cobalt.

Refining the Silver

Much the larger part of the ore raised from the silver mines of Ontario is now treated and refined in the Province. The silver mining industry at Cobalt has undergone a normal course of development since the opening of the mines in 1904. At the beginning the entire output, consisting mainly of high-grade ore and metallic slabs and nuggets, was sent to smelters in the United States; then, as the deposits were opened up and low-grade ore and milling rock began to be encountered, concentration methods were introduced. This was followed by the establishment of refineries in the Province itself, not at Cobalt, but in other parts of Ontario, where plants already in existence could be made use of, or where there was cheap electric power. At a number of the mines themselves, smelting and cyanidation processes were introduced for the production of merchantable bars; and custom concentration and reduction plants were erected. As at the Nipissing mine, specialized methods of treating both high grade and low grade ores were devised and installed, and lastly the introduction of the flotation process for the concentration

of low grade rock and ore gave value to dump piles and large quantities of material that were previously regarded as worthless. The substitution of hydraulically generated electrical power for the steam engine at an early date materially lessened the cost of mine and mill operations. The working of the Mining Tax Act gave the local municipalities a large share of the revenues derived from mines, and enabled a first-class system of automobile roads to be constructed connecting the mines with the railway at Cobalt, and from the outset the Government railway itself, running as it did to the very collars of the mine shafts, effectually averted all transportation difficulties.

The southern Ontario refineries under the encouragement afforded by the Metal Refining Bounty Act not only produced refined silver bars, but also cobalt and nickel oxide, subsequently extending the list of products to include cobalt sulphate, carbonate and hydroxide, nickel sulphate, metallic cobalt and nickel, and stellite, an alloy of cobalt, tungsten and chromium, useful for the making of high-speed tools. Quantities of arsenic are obtained, sold chiefly as white arsenic or arsenious acid, a smaller proportion being disposed of as crude. A little metallic arsenic is also produced. It can thus be seen how large a part in the industrial growth of the Province the silver mining industry has played and continues to play, for the mines are by no means exhausted, and will continue to produce silver for years to come.

The statistics exhibiting the operations of the silver-cobalt refineries of Ontario show that over and above the value of the silver refined, there were produced and marketed from the ores and concentrates treated during 1917 no less than $1,872,744 worth of by-products. This total is exclusive of stellite, of which only one component, cobalt, is derived from these ores.

The refineries in operation were those of the Coniagas Reduction Company, Limited, Thorold; Deloro Smelting and Refining Company, Limited, Deloro, and Metals Chemical, Limited, Welland. The number of workmen employed was 391, and the amount paid out as wages for labour $542,925. Of the material treated, 5,719 tons were ore and concentrates, and 2,245 tons residues. To refineries in the United States there were consignments from Cobalt amounting to 6,307 tons, from which 2,914,267 fine ounces of silver were recovered. These shipments were on the whole of considerably lower grade than those to the home refineries, averaging only 462 ounces of silver to the ton, as against 810 ounces. Much the larger quantity treated by U.S. plants was at the works of the American Smelting and Refining company, Denver, Col., and Perth Amboy, N.J. From 129 tons of gold ore and slag received from Porcupine the U.S. plants recovered 1,958 ounces of silver. Out of the total quantity of silver contained in the product of the Cobalt mines in 1917, namely, 19,401,893 ounces, 14,501,681 ounces were refined at the mines in Cobalt or in Ontario works, being about 75 per cent. of the whole.

OPERATION OF ONTARIO SILVER-COBALT REFINERIES, 1917.

Product.	Quantity.	Value.
		$
Ore, Concentrates and Residues treated.....tons	7,964	.....
Silver recovered .....fine ounces	6,451,363	5,289,782
Arsenic, White, shipments.....lbs.	4,588,793	586,096
Arsenic, Crude, shipments..... "	580,777	17,957
Arsenic, Metallic, shipments..... "	13,575	5,430
Cobalt Oxide, shipments..... "	418,703	533,489
Cobalt Carbonate and Sulphate, shipments ..... "	52,485	13,211
Cobalt, Metallic, shipments ..... "	396,395	589,290
Nickel Oxide, shipments..... "	23,748	6,533
Nickel Sulphate, shipments ..... "	335,794	26,437
Nickel, Metallic, shipments ..... "	225,480	91,923
Cobalt and Nickel Oxides, not separated, shipments.... "	4,757	2,378
Total value of products		7,162,726

The plants in southern Ontario for refining silver and recovering by-products from the ores of the Cobalt camp may be enumerated as follows:—

REFINERS OF SILVER-COBALT ORES, 1917.

Name of Company.	Location of Works.	P.O. Address.
Deloro Smelting and Refining Co., Limited ...	Deloro	Deloro.
Coniagas Reduction Co., Limited	Thorold	St. Catharines.
Metals Chemical, Limited	Welland	Welland.

In Cobalt camp itself, the following mines produce bullion from their own ores: Nipissing, O'Brien and Buffalo, and the first-named also from purchased ores. There are several plants which concentrate ores purchased for the purpose, or act as custom concentrators. These are Cobalt Reduction Company, a subsidiary of the Mining Corporation of Canada, Dominion Reduction Company, and Northern Customs Concentrators, Limited. The first two of these works produce bullion, the last concentrates only. In these three plants there were treated during the year 207,127 tons of ore, of which 1,547 tons were high grade, and 205,580 tons low grade. From the high grade ores were obtained 3,716,612 ounces of silver in bullion form. Concentrates from the low grade ores amounted to 6,290 tons. Shipments of concentrates from the plants consisted of 6,410 tons, containing 4,563,442 ounces of silver, or 712 ounces per ton.

Besides the concentration works proper, a sampling plant has been carried on for a number of years by Messrs. Campbell and Deyell. The business of this firm is confined to ore-sampling (valuing), assaying, and the melting of silver metallics into base bullion. In none of these processes except the melting of metallics are any values extracted. In the sampling process the ore is usually received in 30-ton lots, is crushed in a ball mill, then passed through machines which extract samples, after which the bulk of the ore is bagged and returned to the owners.

The number of employees in the foregoing works was 229, to whom were paid wages amounting to $256,553.

CONCENTRATION AND SAMPLING PLANTS, COBALT, 1917.

Name of Company or Firm.	Location of Plant.	P.O. Address.
Cobalt Reduction Company, Limited	Cobalt	Cobalt.
Dominion Reduction Company, Limited	Cobalt	Cobalt.
Northern Customs Concentrators, Limited	Cobalt	Cobalt.
Campbell and Deyell, Limited	Cobalt	Cobalt.

Refining Bounties on Cobalt and Nickel

By the Metal Refining Bounty Act (R.S.O., 1914, chapter 23) a bounty of six cents per pound was provided on refined cobalt and nickel and the oxides of these metals produced in Ontario from Ontario ores, the bounty being calculated on the metallic contents. There was provision also for a bounty of one and a half cents per pound on refined copper or copper sulphate similarly produced, and on white arsenic made from mispickel one-half cent. per pound. The term of the Act was originally five years from April 20, 1907, but was subsequently extended for another five years from April 20, 1912. It expired in 1917, and was not re-enacted, and the bounties ceased to be payable on April 20, 1917. The Act fixed a maximum amount payable on cobalt and cobalt oxide of $30,000 per annum, and on nickel and nickel oxide of $60,000 per annum, and provided that should the production in any one year be greater than could be paid for by the maximum bounty at the rate specified in the Act, the rate should be correspondingly reduced. In 1916 the cobalt production was in excess, consequently the rate per pound of metallic contents was reduced to 3.9131 cents.

For the broken period from January 1, 1917, until the expiry of the Act on April 20 of the same year, the sum of $16,169.13 was earned by the refining companies, as follows:—

PAYMENTS UNDER METAL REFINING BOUNTY ACT, 1917

Company	Product lbs.	Metallic Contents lbs.		Bounty		Total Bounty
		Cobalt	Nickel	Cobalt	Nickel	
				$ c.	$ c.	$ c.
Deloro Smelting & Refining Co., Ltd.						
Cobalt Oxide	6,400	4,544	.....	272 64	.....	.....
" Metal	20,240	18,225	.....	1,093 50	.....	.....
Stellite	60,736	33,204	.....	1,992 24	.....	.....
Metallic Nickel	29,510	.....	29,067	.....	1,744 02	5,102 40
Coniagas Reduction Co., Ltd.—						
Cobalt Oxide	29,573	21,219	.....	1,273 11	.....	.....
" Metal	82,702	81,122	.....	4,867 33	.....	.....
Nickel Oxide	5,495	.....	3,825	.....	229 47	6,369 91
Metals Chemical, Ltd.—						
Cobalt Oxide	51,706	37,461	.....	2,247 67	.....	.....
" Sulphate	20,366	6,225	.....	373 48	.....	.....
" Hydroxide	7,210	3,967	.....	283 03	.....	.....
Nickel Oxide	7,926	.....	5,292	.....	317 53	.....
" Sulphate	147,506	.....	30,134	.....	1,808 06	.....
" Carbonate	466	.....	201	.....	12 05	4,996 82
Total	.....	205,967	68,519	12,358 00	4,111 13	16,469 13

During the ten years the Metal Refining Bounty Act was in force a total of $170,140.95 was paid out in bounties, details of which are given in the statements which follow. The Act provides a bounty on the refined metals and oxides only. As regards the other compounds and alloys upon which bounty has been paid, it should be pointed out that in the process of refining the ore, the oxides of the metals are necessarily first produced, and are subjected to subsequent manipulation in the preparation of the secondary compounds. The bounty in all cases is calculated on the pure metallic contents only. Nothing has ever been claimed as bounty on copper or arsenic. Large quantities of arsenic were made during the continuance of the Bounty Act, but being a product of the Cobalt silver ores it was not eligible for bounty, which, under the terms of the Act, was payable on arsenic made from mispickel only.

It may fairly be said that the Act was successful in achieving the object aimed at, namely, the establishing of a refining industry in Ontario for the treatment of the Cobalt silver ores, not only for their silver contents, but also for the cobalt and nickel.

TOTAL BOUNTIES PAID UNDER METAL REFINING BOUNTY ACT.

Cobalt

Company	Oxide lbs.	Metal lbs.	Carbonate lbs.	Hydroxide lbs.	Sulphate lbs.	Stellite lbs.	Bounty $
Deloro Smelting and Refining Co., Ltd....	941,989	228,755	.....	.....	.....	118,528	48,930 93
Coniagas Reduction Co., Ltd	1,488,560	224,883	.....	.....	.....	.....	67,174 99
Metals Chemical, Ltd..	234,036	.....	5,723	5,966	84,454	.....	9,577 60
Canadian Smelting and Refining Co., Ltd....	36,137	.....	.....	.....	.....	.....	1,026 05
Standard Smelting and Refining Co., Ltd....	5,026	.....	.....	.....	.....	.....	214 92
Dominion Refineries, Limited	1,550	.....	.....	.....	.....	.....	62 59
Total.....	2,707,298	453,638	5,723	5,966	84,454	118,528	126,987 08

Nickel

Company	Oxide lbs.	Metal lbs.	Sulphate lbs.	Carbonate lbs.	Bounty $
Deloro Smelting and Refining Co. Ltd...	140,754	69,763	.....	.....	8,166 96
Coniagas Reduction Co., Ltd.....	690,782	.....	.....	.....	27,539 01
Metals Chemical, Ltd	57,557	.....	360,215	466	6,776 04
Canadian Smelting and Refining Co., Ltd.	16,156	.....	.....	.....	681 84
Total.....	905,249	69,763	360,215	466	43,153 85

Summary of Bounties Paid

Company	Cobalt	Nickel	Total
	$	$	$
Deloro Smelting and Refining Co., Ltd	48,930 93	8,166 96	57,097 89
Coniagas Reduction Co., Ltd	67,174 99	27,539 01	94,714 01
Metals Chemical, Ltd	9,577 60	6,766 04	16,343 65
Canadian Smelting and Refining Co., Ltd	1,026 05	681 84	1,707 89
Standard Smelting and Refining Co., Ltd	214 92	.....	214 92
Dominion Refineries, Limited	62 59	.....	62 59
Total	126,987 08	43,153 85	170,140 95

The Cobalt Industry

The production of cobalt blue or smalt for use in the manufacture of fine pottery or chinaware, so far as Europe is concerned, originated in Saxony in the early part of the sixteenth century, and has remained in existence there until the present time, but in gradually lessening importance as the ore deposits, very similar to those of Cobalt, were worked out. For a number of years previous to the discoveries in Ontario, the chief source of cobalt ore was New Caledonia, an island owned by France off the eastern coast of Australia. When the mines at Cobalt began to be worked in 1904, the chief metal being silver, cobalt and other constituents were little considered. It soon became apparent, however, that the silver could not be won without at the same time raising large quantities of cobalt, nickel and arsenic, for which practically no market existed. Most of the ore being exported and refined in the United States in plants unprovided with means for the recovery of these substances, they were in the main simply wasted. On refineries for treating the ores being established here, however, they were forced to grapple with the problem of saving the cobalt, etc. This led to investigation of the technical problems involved, and presently the refining companies were in a position to place large quantities of cobalt oxide on the European market, where the principal demand existed. Notwithstanding the strenuous efforts that were made to maintain the high price at which the finished article was sold, say $2.50 per pound, the weight of Ontario competition brought it down by successive stages to 75 or 80 cents per pound. Competition from New Caledonian sources was eliminated, and the Ontario article has continued to dominate the market. So tenacious of established custom is trade that many of the European manufacturers and dealers in cobalt blue simply re-packed the oxide from Ontario in their own packages, marked them with their old labels and sold them as such to their customers to satisfy their demand for the identical article they had been in the habit of using.

The outbreak of the war put an end to the export trade to the continent of Europe, but considerable quantities continued to be sold in England. The growing scarcity of tonnage led to the system of importations being permitted only under license, and also to the prohibition of re-exports from Britain. Previously the far Eastern demand for cobalt oxide had been supplied from London, but now, owing to the conditions brought about by the war, Ontario oxide is transported across the continent by rail and shipped from Seattle or Vancouver to Japan and China. The

demand in the United States and Canada for metallic cobalt has to a large and growing extent taken the place of the former demand for the oxide as a pigment in the ceramic trade. The alloy stellite, composed of cobalt, tungsten and chromium, has been found very useful for the manufacture of high-speed tools for working steel, and is largely used for this purpose by the makers of shells and other war munitions. Although cobalt and nickel are by nature more closely allied than perhaps any other two metals, their effects upon steel seem to be quite different. The addition of cobalt makes steel very hard, a quality necessary for machining tools, such as are used in turning-lathes, planers, etc. On the other hand, nickel makes steel tough, but not hard, hence its usefulness lies in quite other directions, such as increasing the resistance to torsion or strain of any kind. This property has led to an increasing employment of cobalt in the manufacture of special tool steels, intended to be used at high speed, and the greater part of the cobalt required for this use is supplied by the Ontario silver ore refining companies. Cobalt oxide now sells at $1.50 per pound and metallic cobalt at $2.50 per pound. The oxide is converted into metal in the electric furnace. Stocks of cobalt on hand at the refineries are not necessarily at the option of the refiners, since they cannot purchase silver ore or concentrates without taking also the cobalt which these contain. The new uses of which mention has been made have acted as an outlet for much cobalt which in some form or other would otherwise have accumulated at the works. Nevertheless, when peace returns, if trade resumes its wonted channels, there will be cobalt oxide of Ontario origin for all necessary uses so long as the silver mines remain in production, and perhaps longer.

The production of cobalt in metal, compounds and alloys for 1917 was as follows:—

	Produced, lbs.	Shipped, lbs.
Cobalt Oxide	802,448	418,703
Cobalt Metal	393,773	315,327
Cobalt in Stellite	.....	81,068
Cobalt Sulphate and Carbonate	52,485	52,485
Cobalt and Nickel Oxides, not separated	.....	4,757

There is published as Part III of this report, "Cobalt: Its Uses, Alloys, and Metallurgy," by C. W. Drury, Associate Professor of Metallurgy at Queen's University, Kingston, to which reference should be made for full information on the subject. Mr. Drury has obtained a variety of interesting and useful results by experimenting with a number of new alloys of the metal.

Copper

There is a good deal of non-nickeliferous copper ore in Ontario, on the north shore of Lake Huron, at various points west of Lake Superior, and also in the northern and eastern portions of the Province, but, so far, attempts at mining it have not met with large success. Bruce Mines has shown that these sulphide bodies occur in workable dimensions, and it is probable that if better conditions existed with regard to realizing the value of the ores, there would be a considerable production of copper from this source. As it is, copper mining is much hampered by the lack of local reduction works. All ores or concentrates must be shipped to Trail, B.C., or to points in the Eastern States, and the charges for freight and smelter treatment leave little margin, even at the present high price of copper, except in

the case of very rich ore. The Kenyon Copper Company, at Massey, is in a position to treat by flotation 100 tons of ore daily, producing therefrom concentrates containing from 20 to 25 per cent. copper, but operations are not remunerative at the price of copper fixed by the U.S. Government in September, 1917, namely, 23½ cents per pound. The recent revision of this price to 26 cents per pound will afford a somewhat better opportunity.

From the recently opened deposits near Mine Centre shipments were made by H. H. Wood. The Port Arthur Copper Company, which operated and shipped in 1916 under the name of the Mine Centre Copper Company, did considerable development work. The total shipments of ore and concentrates amounted to 4,173 tons, containing 431,402 pounds of copper. In addition, there was a recovery by U.S. refineries of 106,106 pounds of copper from silver ore and concentrates received from Cobalt silver mines, and 2,032 pounds from Porcupine gold slags. The whole production was, therefore, 539,540 pounds, or, say, 270 tons of copper. The Ontario refineries treating the ores and concentrates from Cobalt recognize the presence of a small percentage of copper varying from .4 to 1.24 per cent., but no effort is made to recover it except in one plant, where the by-product is being stocked in an unfinished condition.

Following is a list of the producers of purely copper ores in 1917:—

COPPER ORE PRODUCERS, 1917.

Name of Operator.	Name of Mine.	Location.	P.O. Address of Manager, etc.
Errington, Jos.	.....	Gogama, C.N.Ry...	San Francisco.
Hudson Copper Co., Ltd.	.....	Havilah	Havilah.
*Kenyon Copper Mines, Ltd.	Massey	Sault Branch, C.P. Ry.	Massey.
Ray, S. W.	Tip-Top	Kashabowie	Port Arthur.
Sudbury Copper Co.	.....	Iron Bridge	Toronto.
Wood, H. H.	.....	Mine Centre	Toronto.

*Formerly known as the Sable River Copper Company.

The chief source of the copper production of the province is the nickel-copper ore of the Sudbury area, where the smelters last year turned out 78,897 tons of matte, the copper contents of which were 21,197 tons. This was a decrease of 1,233 tons as compared with 1916, when the smelter product was 80,010 tons of matte containing 22,430 tons of copper. The average copper contents of the matte in 1916 were 28 per cent., and in 1917, 26.8 per cent. Further details regarding the Sudbury nickel-copper industry will be found under the heading of Nickel.

Nickel

The business of mining and smelting the nickel-copper ore of the Sudbury region has grown to large dimensions, as a few statistics will show. Last year 3,356 employees were employed in the mines and works, 1,854 underground, and 1,502 on the surface, to whom were paid wages amounting to $5,570,587. The mines were worked uninterruptedly. For roasting in heaps in the open air, to which process most of the ore is still subjected, some 28,816 cords of wood were required, having a value

of $115,250. To smelt the ore in the blast furnaces and converters 182,091 tons of coke were used, worth $2,187,353. In all, 1,506,828 tons of ore were raised from the mines, and 1,453,661 tons were smelted. The Bessemer matte product was 78,897 tons, the estimated contents of which were 41,887 tons of nickel and 21,197 tons of copper. The average composition of the whole of the matte product was thus 53.09 per cent. of nickel and 26.86 per cent. of copper, being a little higher in nickel and lower in copper than the matte of 1916, when the figures were 51.6 per cent. of nickel and 28 per cent. of copper.

The matte produced by the two smelting companies is quite dissimilar in the proportions of these metals. In 1917 the average contents of the Canadian Copper Company's matte were nickel 56.27 per cent., and copper 23.01 per cent., while the product of the Mond Nickel Company carried 39.57 per cent. of nickel and 43.10 per cent. of copper. This variation of composition reflects the difference in the nature of the ores smelted by the respective companies.

Ore production by the Canadian Copper Company was as follows:—

	Tons.
Creighton mine	1,003,814
Crean Hill mine	113,908
No. 2 mine	1,907
Total	1,139,629

By the Mond Nickel Company:—

	Tons.
Garson mine	116,968
Victoria No. 1 mine	45,972
Worthington mine	75,012
Levack mine	88,587
Bruce mine	34,796
Total	361,335

The Alexo Mining Company raised 5,864 tons of nickel-copper ore from the mine of that name in the township of Dundonald, on the Porcupine branch of the Timiskaming and Northern Ontario railway, all of which was shipped to the Mond Company's works, at Coniston, to be smelted.

One of the most important of recent developments in the nickel industry is the establishment by the International Nickel Company of Canada, Limited, of a large refining plant at Port Colborne, Ont. It had for years been matter for regret that while Ontario was the greatest source of this important metal, it was entirely exported after having been smelted into matte, and the final separation of the nickel and copper was carried on elsewhere. It was shown beyond doubt by the Report of the Royal Ontario Nickel Commission[1] that nickel could be refined in Ontario, and that, so far from the long-maintained contention to the contrary being true, any one of the processes in existence was quite capable of being successfully operated here. Neither climatic conditions, want of skilled labour or chemicals, nor the cost of assembling the fuel, acids and other necessaries for the process, when put to the test proved to be an insuperable difficulty, and the Port Colborne refinery is now in operation. The process employed is the Orford one with variations, and the capacity of the works is 10,000 tons of nickel per annum, with a relative quantity of copper. A description of the plant is given elsewhere in this Report.

[1] A. T. Wilgress, Printer to the King's Most Excellent Majesty, Toronto, 1917.

Blast Furnace, Roasting Buildings and Cottrell Plant.

Administration Group of Buildings.

The two illustrations show the new Port Colborne plant of the International Nickel Company of Canada, Limited July, 1918.

It was expected that the British America Nickel Corporation, Limited, which is developing the large nickel-copper ore body known as the Murray mine, near Sudbury, would have followed suit by the erection of a refinery near the mine. The difficulty of procuring the necessary quantity of electrical power in the locality, however, proved too great to be overcome, and after considerable search the company decided to erect the refining works on the Quebec side of the Ottawa river near Hull, where sufficient energy could be obtained from that river, and ground has now been broken for the necessary buildings. The smelting plant is being constructed at the mine.

Table VIII. summarizes the course of the nickel-copper mining industry during the five years ending 1917. It will be seen that the tonnage of ore raised in 1917 was twice as great as that in 1913, the quantity smelted 76 per cent. more, the matte produced was 70 per cent. more, and the nickel and copper contents greater respectively by 68 and 63 per cent. The value of the nickel increased by 15¾ millions of dollars, and of the copper by upwards of 6 millions of dollars; these increases, however, are in part due to the higher prices adopted for computation. It is noteworthy that while the actual number of workmen was 156 smaller in 1917 than in 1913, the wages paid were 2¼ millions of dollars more. That is to say, the average earnings of the employees rose from $937 each in 1913 to $1,659 each in 1917, an increase of 77 per cent.

TABLE VIII.—NICKEL-COPPER MINING AND SMELTING, 1913-1917.

Schedule.	1913	1914	1915	1916	1917
Ore raised.....tons.	784,697	1,000,364	1,339,322	1,572,804	1,536,828
Ore smelted..... "	823,403	947,053	1,272,283	1,546,215	1,453,661
Bessemer matte produced.. "	47,150	46,396	67,703	80,010	78,897
Nickel contents of matte .. "	24,838	22,759	34,039	41,299	41,887
Copper contents of matte... "	12,938	14,448	19,608	22,430	21,197
Value of Nickel in matte.... $	5,237,477	5,108,997	17,019,500	20,649,279	20,943,500
Value of Copper in matte... $	1,839,438	2,080,034	3,921,600	8,299,051	7,842,890
Wages paid..... $	3,291,956	3,131,520	3,581,639	4,920,720	5,570,587
Men employed	3,512	3,464	4,178	4,730	3,356

The companies engaged in nickel-copper mining in 1917 were as follows:—

NICKEL-COPPER PRODUCERS, 1917.

Name of Company.	Name of Mine.	P.O. Address.
Canadian Copper Company	Creighton, Crean Hill, etc.	Copper Cliff.
Mond Nickel Company, Limited	Garson, Levack, etc...	Coniston.
The Alexo Mining Co., Ltd.	Alexo	Porquis Junction.

From the silver ores of the Cobalt mines there were produced in the Ontario refineries 225,480 pounds of metallic nickel, mostly in the form of shot, of about 98 per cent. purity. This is sold to manufacturers of platers' supplies and made into anodes. A market for metallic nickel has also been found in Italy, where it

is used in the structure of airplanes. The present capacity of the silver ore refineries for the production of metallic nickel is about 400 tons per annum. There are considerable stocks of nickel-bearing residues and nickel oxide at present on hand. Nickel sulphate is also being produced, a large use for which is in the hardening of oils and fats. A considerable quantity of nickel oxide was made during the year, as this form is the one in which the nickel is recovered from the ore, but only a small portion was marketed as oxide, most of it being converted into metallic nickel or nickel sulphate and sold as such. Some 4,757 pounds of unseparated oxides of nickel and cobalt were also sold, the value being $2,378.

Iron Ore and Pig Iron

Of the 176,833 tons of iron ore marketed in 1917, there were 136,343 tons exported to the United States. The balance went to Ontario blast furnaces. There were three producers: Moose Mountain, Ltd., also the Magpie and Helen mines of the Algoma Steel Corporation, Ltd. The last-mentioned shipped to the Magpie, where the ores from the two mines were mixed and treated in the roasting furnaces to produce a Bessemer grade of ore. Shipments from Moose Mountain were in the form of concentrates and briquettes. The number of men employed in the mines was 475, and the wages paid them amounted to $493,078.

Blast furnaces at Sault Ste. Marie (3), Hamilton (2), Port Colborne (1), and Deseronto (1) smelted 94,318 tons of Ontario ore and 1,221,881 tons of imported ore, producing therefrom 691,233 tons of pig iron valued at $14,201,695. It may be noted that only 7.16 per cent. of the value of the pig iron output can be credited to domestic ore.

Business was exceedingly brisk in the making of pig iron last year. The insistent demands of the war called for more and more iron, more and more steel, and the ordinary industrial requirements were for the time being obliged to accept scant consideration. This was also the condition in the United States, and in both countries the industry was strictly controlled. The two leading companies produced 862,504 tons of steel, consuming for the purpose a much larger quantity of pig iron than they made themselves. The total product of pig iron was 7,969 tons less than in 1916. The price of pig iron rose nearly 50 per cent., the average valuation for 1916 being 13.94 per ton, while in 1917 it was $20.54. Steel was returned in 1916 at an average valuation of $18.70 per ton; last year the figures were $25.13 per ton.

Electro-Metals, Limited, Welland, produced a large tonnage of ferro-silicon, using quartzite, ganister rock, and pyrites cinder.

The undermentioned companies operated blast furnaces in 1917:

IRON BLAST FURNACES IN OPERATION, 1917.

Name of Company.	No. of Furnaces operated	Fuel used.	Location.
Algoma Steel Corporation, Limited.....	3	Coke	Sault Ste. Marie.
Canadian Furnace Company, Limited...	1	Coke	Port Colborne.
Standard Iron Company, Limited	1	Charcoal and Coke	Deseronto.
Steel Company of Canada, Limited.....	2	Coke	Hamilton.

Table IX gives particulars of the iron and steel-making industry of the Province for the last five years.

TABLE IX.—PRODUCTION IRON AND STEEL, 1913 TO 1917.

Schedule.	1913	1914	1915	1916	1917
Ontario ore smelted .....tons	132,708	163,779	293,305	215,366	94,318
Foreign ore smelted ..... "	1,095,561	752,560	623,094	1,056,810	1,221,881
Limestone for flux ..... "	351,741	252,258	215,686	296,988	319,535
Coke ..... "	706,852	590,902	486,022	708,273	723,657
Charcoal .....bush.	2,206,191	920,045	1,314,957	1,843,209	1,288,390
Pig iron produced .....tons	648,899	556,112	493,400	699,202	691,233
Value of pig iron produced ..... $	8,719,892	7,041,079	5,910,625	9,739,704	14,201,695
Steel made .....tons	648,948	479,320	471,059	686,959	862,594
Value of steel made ..... $	11,230,109	7,786,303	7,618,272	12,847,309	22,179,982

Molybdenite

The production of molybdenite concentrates in Ontario in 1917 was 77,517 pounds, an increase over 1916 of 52,955 pounds. The use of molybdenite in the manufacture of special tool steels, owing in part to the scarcity of tungsten, has led to a good deal of prospecting for deposits, and to the opening up and working of some of the most promising. Occurrences of molybdenite are apt to be pocketty and irregular, but are occasionally on a large scale, such as the mine now being worked at Quyon, Que. The alloy ferro-molybdenum, in which form the mineral is used by steelmakers, was made last year at Orillia and Belleville, the production being about 150,000 pounds.

Following is a list of the owners, with their addresses, from whose properties shipments of molybdenite were made:—

MOLYBDENITE SHIPPERS IN 1917.

Name.	Location of Deposit.	P.O. Address.
Armstrong, R. M.	Ashdod	Toronto, 13 Adelaide St.
Bourgault, M. A.	Calabogie	Ottawa, Marine Dept.
Canadian Molybdenite, Ltd.	Bagot township	Toronto, 801 Kent Bldg.
Foley, M. L.	Ross township	Toronto, 12 Maynard Ave.
Grey & Grey	Wilberforce	Toronto, 43 Imperial Life Bldg.
International Molybdenum Co., Ltd.	Mount St. Patrick	Renfrew.
Kelly, Mrs. W. R.	Tamworth	Tamworth.
McCoy, W. C.	Lyndoch township	Schutt.
Ontario Molybdenum Co., Ltd.	Tory Hill	Toronto, 305 Mail Bldg.
Opeongo Mining Syndicate	Opeongo	Renfrew.
Padwell, George	Monmouth township	Wilberforce.
Renfrew Molybdenum Mines, Ltd.	Brougham township	Montreal, Que. 402 Southam Bldg.
Spain, William J.	Dacre	New York, 417 Fifth Avenue.
Taylor, A. W.	Bagot township	Toronto, 123 Bay Street.

W. E. Joiner, of Moline, Ill., is engaged in developing molybdenite showings in the township of Cardiff, district of Haliburton, near Wilberforce station, on the Irondale, Ottawa, and Bancroft railway. One of these, owned by the Paudash Lake Molybdenite Mines, Limited, is on lot 18 in the ninth concession, where

the mineral occurs in large crystals. The other, known as the Joiner property, is on the north half of lot 3 in the twentieth concession. Frank C. Loring, M.E., states that the mineralized area on the latter has a northerly and southerly extent of about 1,500 feet and an easterly and westerly width of 150 to 400 feet, the ridge on which it occurs rising 100 to 150 feet above the low ground adjoining. A number of pits and trenches opened on the ridge and westerly slope have exposed molybdenite. In Mr. Loring's opinion the indications are promising for the presence of a large quantity of the mineral. Mr. Joiner proposes to further test the property by a number of open cuts across the ridge easterly and westerly from rim to rim, by blasting off the face of the bluff, and by diamond drilling.

Concentrating plants in operation were as follows:—

MOLYBDENITE CONCENTRATORS, 1917.

Concentrator.	Tons ore treated.	Lbs. concentrates produced.
International Molybdenum Company, Limited, Renfrew.	419.5	11,578
Mines Branch, Mines Department, Ottawa	250.8	6,521
Renfrew Molybdenum Mines, Limited, Mt. St. Patrick..	3,656.5	57,254
Total	4,326.8	75,353

In electric furnaces at Orillia and Belleville, ferro-molybdenum was produced as follows:—

FERRO-MOLYBDENUM PRODUCERS, 1917.

Refinery.	Location	Ferro-Molybdenum lbs.
International Molybdenum Co., Limited	Orillia	81,000
Tivani Electric Steel Co	Belleville	69,000
Total		150,000

The value of the ferro-molybdenum product was $349,355.

A comprehensive account of molybdenite in Ontario was contained in a report by Arthur L. Parsons, published in the twenty-sixth annual volume of the Bureau, 1917.

Lead

The production of ore last year amounted to 16,602 tons, compared with 6,481 tons in 1916. The output was almost wholly from the mine at Galetta, in Carleton County, owned by the James Robertson Estate, Montreal. A few tons were raised by the North Victoria Mines, Limited, from a property near Kinmount, in the district of Haliburton, and a small quantity of concentrates from the old Frontenac lead mine were smelted by the Kingston Smelting Company, Limited, although the mine itself was not worked. The Galetta smelter and that of the Kingston Smelting Company turned out a total of 4,228,512 pounds of pig lead,

valued at $316,531, of which 1,772,512 pounds, worth $172,601, were from Ontario ore, and 2,456,000 pounds, worth $243,933, from ore imported from outside points.

The number of mine employees was 74 and of smelter hands 47, total 121. Wages paid, mines $51,029, smelters $31,499, total $85,528.

LEAD ORE PRODUCERS, 1917.

Name of Company.	Location of Mine.	P.O. Address.
Estate of James Robertson	Galetta	Montreal.
North Victoria Lead Mines, Limited	Kinmount	Toronto.

LEAD ORE SMELTERS, 1917.

Name of Company.	Location of Smelter.	Address.
Estate of James Robertson	Galetta	Montreal.
Kingston Smelting Company, Limited	Kingston	Kingston.

Materials of Construction

Clay Products

The clay industry in war time may be regarded as more or less non-essential. In the United States the Fuel Administration has taken this view, hence orders have been issued curtailing the output of clay products for 1918 from 15 to 50 per cent., and placing the entire manufacturing programme on a war basis. In Ontario many brick and tile plants were idle throughout the year 1917.

Though the value of clay products has risen considerably during 1917 owing to high operating costs, the output also shows a small increase as compared with 1916. This does not appear to be the case with tile and hollow ware as far as quantity is concerned, but it may be pointed out that such products should be reported on a tonnage rather than a numerical basis, because of the wide range both in size and shape of drain and building tile. Building permits in Toronto in 1917 exceeded in number those of 1916 by 12 per cent., but the total value of the buildings was 28 per cent. less.

Pressed and Fancy Brick.—The output of pressed and fancy brick in 1917 was 36,233 M, worth $474,614, as compared with 31,742 M, worth $318,912, in 1916. Of this production the Milton Pressed Brick Company contributed over one half. Wages amounting to $206,811 were paid to 407 employees.

Common Brick, Drain and Building Tile.—Apart from two large makers of building tile, hollow clay blocks are produced only to a limited extent, and chiefly in localities where gravel is scarce. They are used for barn foundations and for other buildings such as chicken and pig pens, milk houses, garages, etc., since they

afford a dry, warm wall that can be cheaply erected. Sizes vary: 4 by 4 by 12; 4 by 8 by 12 and 6 by 10 by 12 inches being common. Smaller sizes are used for interior walls in houses. The large makers in Ontario are the National Fireproofing Company of Canada, Limited, and the Sun Brick Company.

The average period of operation for the brick and tile plants was 131 days in the year 1917. Many of the smaller plants operate in the summer months only. Employees numbered 909, and $473,375 was paid in wages.

As fuel and labour costs continue to advance, the cost of manufacturing clay products increases. In 1917 for common brick, also drain and building tile, the following figures show the output, value, fuel consumption, and cost:—

OUTPUT AND VALUE OF BRICK AND TILE, 1917.

Product	M.	Value $	Value per M.
Common Brick	68,214	713,824	$10 46
Drain Tile	15,940	546,040	.....
Hollow Building Tile	3,933	301,688	.....

FUEL CONSUMPTION.

Wood			Coal or Coke			Natural Gas		
Cords	Value $		Tons	Value $		M. cu. ft.	Value $	
	Total	per cord		Total	per ton		Total	per M.
17,289	74,258	4 29	19,856	150,802	7 59	157,180	24,712	0 16

Following is a list of the brick and tile operators who reported an output in 1917:—

BRICK AND TILE PLANTS.

Name.	Address.	Product.
Alvinston Brick & Tile Co., Ltd.	Alvinston	Brick, Tile and Hollow Blocks.
Armstrong Bros	Fletcher	Tile.
Attercliffe Standard Brick, Block & Tile Co.	Attercliffe	Tile.
Arnott, Thos. H.	Bracebridge	Brick.
Baird & Son, H. C.	Parkhill	Brick and Tile.
Baker, Geo. E.	Arnprior	Hollow Blocks.
Baker Bros.	Casselman	Brick.
Bell Bros.	Paisley	Brick.
Bogart Bros.	Southwold	Tile.
Bond & Bird	Woodstock, R.R. No. 5.	Brick.
Brampton Pressed Brick Co., Ltd.	Brampton	Pressed Brick.
Broadwell & Son, B.	Kingsville	Tile.
Brown, J. W.	Vienna	Tile.
Brownscombe, H.	Cargill	Brick and Tile.
Brownscombe Bros.	Paisley, R.R. No. 2	Brick and Tile.
Buck, J. L.	Port Rowan	Brick and Tile.
Butwell, Henry	Toronto	Brick.

BRICK AND TILE PLANTS.—*Continued.*

Name.	Address.	Product.
Cabana, Jr., Oliver	Zurich	Brick and Tile
Cairo Brick and Tile Works	Cairo	Brick and Tile
Campbell, Neil F.	West Lorne	Tile.
Canada Sand-Lime Pressed Brick Co., Ltd.	West Toronto	Sand-Lime Brick.
Canadian Pressed Brick Co., Ltd.	Hamilton	Pressed Brick.
Clark, Walter	Corunna	Brick and Tile.
Cooper, W. H.	Hamilton	Brick.
Curtin, Frank	Lindsay	Brick.
Curtis Bros.	Peterboro', R.R. No. 9	Brick and Tile.
Deller & Sons, Geo.	Norwich	Brick, Tile and Hollow Blocks.
Deller, Wm. H.	Thorndale, R.R. No. 4	Tile.
Dochart Brick & Tile Works	Arnprior	Brick, Tile and Blocks.
Dolan, John	Watford, R.R. No. 2	Tile.
Dominion Sewer Pipe Co., Ltd.	Aldershot	Brick and Tile.
Don Valley Brick Works	Todmorden	Common, Pressed and Fancy Brick.
Elliott, Chas.	Bluevale	Brick and Tile.
Elliott & Sons, Jas.	Steelton	Brick.
Fox, G. J.	Dresden	Brick.
Frank, E. D.	Strathroy, R.R. No. 6	Brick and Tile.
Frid Bros.	Hamilton	Brick.
Frost, Geo. H.	Toronto	Brick.
Gardiner, William	Blenheim	Brick and Tile.
Govenlock, J. M.	Seaforth, R.R. No. 1	Tile.
Hallatt, H.	Comber	Brick and Tile.
Halton Brick Co., Ltd.	Terra Cotta	Pressed Brick.
Hamilton Pressed Brick Co., Limited	Hamilton	Pressed Brick.
Hepworth Silica Pressed Brick Co., Ltd.	Hepworth	Pressed Brick.
Hill Brick Co.	Madoc	Brick.
Hill, A. W.	Coatsworth, R.R. No. 1	Brick and Tile.
Hinde Bros.	West Toronto	Brick.
Hiscock & Sons	Cobourg	Brick.
Hitch, Mrs. Susan	Ridgetown	Brick, Tile and Hollow Blocks.
Hitch, Thos.	St. Thomas	Brick and Tile.
Hohl, John	Wellesley, R.R. No. 1	Brick and Tile.
Holland & Son, William	Ruscomb	Tile.
Holton, R. J.	Clifford, R.R. No. 3	Tile.
Howlett, Fred.	Petrolia	Tile.
Interprovincial Brick Co. of Canada, Ltd.	Cheltenham	Pressed Brick.
Janes, D. A.	Delaware	Brick and Tile.
Jasperson, B.	Kingsville	Brick, Tile and Hollow Blocks.
Jervis & Son, John	Dorchester Station	Brick and Tile.
Jordan, D.	Chatham	Brick and Tile.
Kaar, John	Brownsville	Brick and Tile.
Koebel, Joseph Z.	St. Clements	Brick and Tile.
Kruse Bros.	Egmondville	Brick and Tile.
Kuhn, Henry J.	Crediton	Tile.
Labey & Son, Geo. A.	Foxboro'	Tile.
Leamington Brick & Tile Co., Ltd.	Leamington	Brick and Tile.
Lindsay, Stephen	Wallaceburg, R.R. No. 2	Tile.
Logan Brick Works	Toronto	Brick.
Lowe, Jos.	Meaford, R.R. No. 1	Tile.
Lowes, Gordon	Kent Centre	Brick and Tile.

BRICK AND TILE PLANTS.—*Continued.*

Name.	Address.	Product.
MacKay Bros.	Dutton	Brick and Tile.
McCredie & Reid	Belmont, R.R. No. 3	Brick and Tile.
McGibbon, Dugald	Shedden	Tile.
McLoughlin, John	London	Brick.
Marshall, W. W.	Woodstock	Brick and Tile.
Martin, David	Thamesville	Brick and Tile.
Middleton, Chas.	Wyoming	Tile.
Milton Pressed Brick Co., Ltd.	Milton	Pressed and Fancy Brick.
Miner, J. T.	Kingsville, R.R. No. 2	Brick and Tile.
Napanee Brick & Tile Co., Limited	Napanee	Brick and Tile.
National Fire Proofing Co. of Canada, Ltd	Aldershot	Hollow Blocks.
Naylor & Sons, J. W.	Trenton	Brick.
New, Edward	Hamilton	Brick.
Norton, Alsey	Bolton	Tile.
Odell & Sons, Wm.	Ingersoll	Brick, Tile and Blocks.
Ollman Bros.	Hamilton	Brick,
Ontario Paving Brick Co., Limited	West Toronto	Brick.
Ott Brick & Tile Mfg. Co., Limited	Kitchener	Brick.
Ottawa Brick Mfg. Co., Limited, The	Ottawa	Brick.
Owen Sound Brick Co., Limited	Owen Sound	Brick.
Parks, H. W.	Dresden	Tile and Hollow Blocks.
Paxton & Bray	St. Catharines	Brick.
Pears & Son, James	Toronto	Brick.
Pembroke Brick Co., The	Pembroke	Brick.
Petty, Chas.	Cherrywood	Tile.
Phillips & Son, Thos.	Lucknow, R.R. No. 1	Tile.
Phinn, Geo. E.	Lucan	Brick, Tile and Hollow Blocks.
Port Credit Brick Co., Limited, The	Port Credit	Common and Pressed Brick.
Price Estate, John	Toronto	Brick.
Provincial Secretary's Department	Mimico	Drain, Floor and Building Tile; Brick.
Richardson & Son, James	Kerwood	Brick and Tile.
Ries, John	Carlsruhe	Brick and Tile.
Russell, Joseph	Toronto	Brick.
Sadler, F. L.	Dublin	Brick and Tile.
Silicate Brick Co. of Ottawa, Ltd.	Ottawa	Sand-Lime Brick.
Sipprell, J. H.	Wilkesport	Tile.
Smith & Son, Alex.	Dutton, R.R. No. 2	Brick and Tile.
Snelgrove & Teer	Beaverton	Brick and Tile.
Stickwood, Chas.	Newmarket	Brick.
Sudbury Brick Co., Limited	Sudbury	Brick.
Sun Brick Co., Limited	Toronto	Fancy Brick and Hollow Blocks.
Thompson Bros.	Essex	Brick and Tile.
Thornton, John	Perth	Brick.
Toronto Brick Co., Limited	Toronto	Sand-Lime Brick.
Wagstaff, Chas.	Lindsay	Brick and Tile.
Waite, J. E.	Forrester's Falls	Brick and Tile.
Wallace & Son, R.	North Bay	Brick.
Wallaceburg Brick Co.	Wallaceburg	Brick.
Warwick Brick Works	London	Brick.
Watson Brick Co.	Bracebridge	Brick and Tile.
Wood, W. H.	Brockville	Brick.
Wright, J. C.	Proton	Brick and Tile.
Yaeck, Louis	Walkerton	Brick and Tile.
York Sandstone Brick Co., Limited	East Toronto	Sand-Lime Brick.

Pottery.—No high-grade pottery is manufactured in Ontario, the glacial clays not being suited for the purpose. The value of pottery made in 1917, as reported by the producers mentioned below, was $94,501. Wages paid 11 employees amounted to $35,318.

The following is a list of operators in 1917:—

POTTERY PRODUCERS, 1917.

Name.	Address.
R. Campbell's Sons	Lock St. South, Hamilton.
J. Cranston Estate	216 Dundurn St. South, Hamilton.
Davis, Joseph S.	1967 Yonge St., Toronto.
Foster Pottery Company	Main St. West, Hamilton.
Taylor, Geo. M.	Port Hope.

Sewer Pipe.—There are three companies making sewer pipe in Ontario. Raw material suitable for sewer pipe purposes is not widely distributed. It is a plastic Medina shale free from lime, and the entire quantity comes from the vicinity of Waterdown, near Hamilton. Sewer pipe manufacture involves careful manipulation in order to secure a high percentage of perfectly vitrified, salt-glazed and unwarped pipe.

Sewer pipe marketed in 1917 was worth $378,923. The wages paid 202 men employed in the industry amounted to $168,421.

Following is a list of the companies:—

SEWER PIPE WORKS, 1917.

Name of Company.	Location of Plant.	P.O. Address of Manager, etc.
Dominion Sewer Pipe Co., Ltd.	Swansea	Swansea.
Hamilton & Toronto Sewer Pipe Co., Ltd.	Hamilton	Hamilton.
Ontario Sewer Pipe Co., Ltd.	Mimico	Mimico.

Brick, Tile, Sewer Pipe and Pottery

The following table shows the comparative value of the output of clay products since the outbreak of war:—

Year.	Brick.		Pottery.	Drain Tile.	Sewer Pipe.	Total.
	Common.	Pressed, Fancy, Terra Cotta, etc.				
	$	$	$	$	$	$
1914	2,336,207	894,384	25,720	277,530	571,756	4,105,597
1915	763,591	375,865	49,387	321,253	361,283	1,871,379
1916	509,559	495,895	87,025	275,471	216,749	1,584,699
1917	713,824	776,302	94,501	546,040	379,923	2,509,590

Refractory Clay from Mattagami River

Hitherto clays have not been found in Ontario suitable for making chinaware or porcelain, and in consequence the pottery trade of the Province has not been able to advance beyond the coarsest kinds of ware, such as flower pots, jardinieres, etc., except by the use of imported clays.

A dissovery made by Capt. C. M. McCarthy, of Elk Lake, on the east bank of the Mattagami river, opposite an island at the foot of the Long Portage, has shown the existence there of a deposit of excellent white fire clay of highly refractory character, believed to be capable also of taking the place of English "ball" clay in the manufacture of porcelain. An examination of the clay was made by Prof. Geo. A. Guess, of the University of Toronto, in November, 1917, who reported that it was a good grade of ball clay, the following being a partial analysis:—

	Per cent.
Silica	52.7
Alumina	32.1
Iron	Trace
Lime	Trace

It had a very high plasticity, and an air shrinkage of 6.7 per cent. Burned to cone 5 (1,230° C.) it showed a shrinkage of 14.8 per cent. The colour on burning was almost white—a slight cream colour. The test pieces on burning cracked after the manner of undiluted ball clay.

A fuller analysis by W. K. McNeill, Provincial Assayer, gave the following composition:—

	Per cent.
Silica	53.10
Alumina	31.98
Ferric Oxide	1.52
Ferrous Oxide	Nil
Lime	0.51
Magnesia	Trace
Soda	0.54
Potash	0.28
Loss on ignition	12.35
Total	100.28

Samples were sent to the Canadian Porcelain Company, Limited, Hamilton, who undertook to give them a practical test. After doing so, the company reported as follows on 10th January, 1918:—

> We fired samples of the ball clay of Capt. C. M. McCarthy in our kilns and find that the same is practically as plastic as the English ball clay, but has a slightly greater shrinkage. We believe that the clay would be satisfactory for use in porcelain bodies after proper allowance had been made for the variation in the shrinkage.

The clay was also tested at the Mines Department, Ottawa, J. Keele, chief ceramic engineer, reporting it to be a light grey to white clay when dry, and requiring 23 per cent. of water to bring it to the best working consistency. It had good plasticity and working qualities. Its drying qualities were good, and the shrink-

age of dried test pieces was 6 per cent. It burned to a porous but strong body of nearly white colour at the lower temperatures or up to 2,100° Fahr. When burned to temperatures higher than this the body became slightly denser and cream-coloured. When raised to temperature of cone 33 (3,254° Fahr.) the clay softened. Mr. Keele pronounced it a No. 1 fire clay, and one of the most refractory clays yet found in Canada. Its working, drying, and burning qualities were very satisfactory, so that it could be moulded into special shapes for refractory purposes.

In making pottery trials, the clay was thoroughly mixed with an excess of water and washed through a 200-mesh screen. The residue remaining on the screen was 20 per cent. of the original weight and consisted almost wholly of small quartz grains. The washed clay was dried, and a mixture was made consisting of 50 per cent. of the clay, 20 per cent. ground feldspar, and 30 per cent. ground quartz. This mixture was made into a slip and cast in the form of small cups. These were burned at a low temperature and four of them sent to the Mayer China Company, of Beaver Falls, Pa., where they were burned in the china biscuit kiln to cone 10, and glazed and re-fired in the china glost kiln at cone 4. The pieces turned out had a beautiful ivory tone, but were not suitable for china or semi-porcelain wares, for which a white colour is strictly required.

Mr. Keele adds that the clay could be used to advantage in making sanitary porcelain, vitrified floor tiles and wall tiles, or probably for electric porcelain. Much of the china clay imported for these purposes is not as good a colour as the Mattagami clay, and a little cobalt stain added to this clay would materially improve the colour.

A sample of red clay, found on the same property, proved on testing to be very plastic and smooth, being rather more plastic than the white clay. It burned to a red colour and hard, dense body at about 2,200° Fahr. It fused at cone 20 (2,786° Fahr.), so that it is not a fire clay, but only semi-refractory. A good fire brick could probably be made from a mixture of one part red clay with two parts of white clay, and a similar mixture could also be used for the manufacture of stoneware pottery.

In June, 1918, Capt. McCarthy reported he had pretty thoroughly investigated this deposit of clay by sinking pits, digging trenches, and putting down auger holes. He is convinced the clay occurs over the whole width of his claim of 40 chains, and that it is about 100 feet or over in depth. The red clay lies to the south of the white.

Lime

The output of lime last year as shown in Table II was 2,820,507 bushels, valued at $1,111,264, while that for 1916 was given as 1,453,254 bushels, worth $657,364. The large increase in production is explained by the fact that heretofore the lime made by large manufacturing concerns such as the American Cyanamid Company and the Dominion Sugar Company for use in their processes was not included in the statistics, since it did not come upon the market for sale as lime. It would seem, however, that for whatever purpose the lime is used, whether in manufacturing or treating other products, or for building, the figures ought properly to be

reckoned in the general total. The two companies mentioned produced in 1917 nearly 1,000,000 bushels. It will be noted that while the price in 1916 averaged 18.6 cents per bushel, in 1917 it rose to 23.3 cents. The making of lime tends more and more to fall into the hands of the large operators. The day of the small kiln worked by the farmer or his boys, spasmodically and to supply the needs of a very local and restricted market, has virtually passed. In this, as in every other manufacturing industry, proper organization, technical skill and sufficient capital are necessary. For fuel in burning, wood is still largely used, but more lime is now burned with coal than any other fuel. Coke is also employed, and a few makers use natural gas. The number of men employed was 325, and the wages paid $262,132.

Below are given the names of producers and the location of plants in Ontario which operated in 1917:—

LIME PRODUCERS, 1917.

Name of Owner or Company.	Location.
American Cyanamid Co.	Niagara Falls.
Beachville White Lime Co., Limited	Beachville.
Bergin, Patrick	Napanee.
Cameron, W. M.	Carleton Place.
Canada Lime Company, Limited	Coboconk.
Chalmers & Campbell	Owen Sound.
Chestnut, W. D.	Duntroon.
Christie, Henderson & Co., Limited	Puslinch, Kelso and Hespeler.
Contractors' Supply Co., Limited	Melville Junction and Teeswater.
Delta Lime Co., Limited	Delta.
Dominion Sugar Co., Limited	Wallaceburg, Chatham and Kitchener.
Elora White Lime Co., Limited	Elora.
Gallagher Lime & Stone Co., Limited	Hamilton.
Guest, Mrs. E. J.	Ancaster.
Harvey, E., Limited	Rockwood.
Higginson & Stevens	Hawkesbury.
Jamieson, J. M.	Forrester's Falls.
Jamieson Lime Co.	Renfrew.
McGilvray, James	Priceville, R.R. No. 2.
McTernan, John	Torbolton.
Marshall Lime & Cement Works, Jas.	Hamilton.
Parks Bros.	Troy.
Robertson Co., D., Limited	Milton.
Smith, John S.	Inverhuron.
Standard Chemical Iron & Lumber Co., Limited	Eganville.
Standard White Lime Co., Limited	Beachville, Guelph, and St. Marys.
Toronto Brick Company, Limited	Coboconk.
Toronto Lime Co., Limited	Limehouse and Dolly Varden.
Weppler, Henry	Priceville, R.R. No. 1.

Portland Cement

The quantity of cement made in Ontario factories and sold in 1917 shows a small decline as compared with 1916. Building construction was hampered through scarcity of labour, and hence the demand was less. Barrels of cement marketed in 1916 were 2,143,949, valued at $2,242,433, while the 1917 figures were 2,063,231

and $2,934,271, respectively. The average price per barrel, however, rose from $1.05 to $1.42. Cement on hand at the end of the year totalled 567,261 barrels.

The industry employed 589 men in 1917, and wages paid amounted to $538,355.

The following cement plants were operated:

PORTLAND CEMENT PLANTS, 1917.

Name of Company.	Location of Plant.	P.O. Address of Manager, etc.
Canada Cement Company, Limited, Plant No. 5 ..	Thurlow tp., near Belleville	Herald Bldg., Montreal, Que.
do do do No. 8 ..	near Port Colborne...	do do
The Hanover Portland Cement Co., Limited	Hanover	Hanover.
National Portland Cement Co., Limited	Durham	Durham.
The Ontario Portland Cement Co., Limited	Blue Lake	Brantford.
St. Marys Portland Cement Co., Limited	St. Marys	St. Marys.

The following works were not operated during the year: Canada Cement Company, Limited, Plant No. 4, Thurlow; No. 5, Hungerford; No. 7, Lakefield; No. 9, Shallow Lake; Union Cement Company and Imperial Cement Company, Owen Sound. The last-named company is defunct. The Maple Leaf Cement Company, Atwood, and the Kirkfield Portland Cement Company, Raven Lake, were also idle.

Cement Products

From the Portland cement made from clay and limestone or marl, cement brick, blocks, tile and sewer pipe are manufactured. The demand for tile is increasing, and in many localities cement tile are competing successfully with the clay product, particularly for large sizes. As sand, gravel and cement are recorded in the table of production it has not been thought advisable to include cement products in the total valuation of the mineral output of the Province.

Returns received show an output as follows for the year 1917:—

Product.	Number.	Value
Cement Brick	130,000	$1,420
Cement Blocks	48,661	8,312
Cement Tile and Sewer Pipe.....	2,412,787	90,586
Total	.....	$100,318

The industry employed 105 men and $28,641 was paid in wages. The average time the producers operated was 105 days.

The following list gives the names and addresses of manufacturers of cement products reporting to the Bureau of Mines:—

MANUFACTURERS OF CEMENT PRODUCTS, 1917.

Name.	Address.	Product.
Andrews, S. J.	Clinton	Blocks and Tile.
Beuglas, Jas.	Bright, R.R. No. 3	Tile.
Brennan & Hollingworth	Hamilton	Tile.
Clark, W. H.	Gananoque, R.R. No. 3	Blocks.
Corlett, A. S.	Leamington	Brick.
Deline, L.	Enterprise	Blocks and Tile.
de Jersey, O. W.	Forest	Blocks.
Deveney & Campbell	St. Marys	Blocks and Tile.
Dillon, Jno.	Seeley's Bay	Tile
Fletcher & Sons, J. H.	Fonthill	Blocks.
Greee, G. C.	Wallaceburg	Blocks and Tile.
Hagerman, A. V.	Odessa	Tile.
Hay & Son, J. C.	Listowel	Tile.
Hoy, William J.	Prescott	Brick, Blocks and Tile.
Hyndman, Jno.	Gorrie	Tile.
Iler Concrete Tile Co.	Arner	Tile.
Karr & Rose	Petrolia	Tile.
Kilgour, D. G.	Eganville	Tile.
Kinzel & Son, Jos.	Preston	Blocks and Tile.
McLenaghan, W. A.	Essex	Blocks and Tile.
McQueen, Alex.	Arthur	Tile.
Malcolm, Jno.	Fergus.	Tile.
Markus, Wm., Ltd.	Pembroke	Blocks.
Mitchell, Frank	Pickering	Tile.
Moore, D. G.	Ailsa Craig	Blocks and Tile.
National Concrete Co.	Lindsay	Blocks and Tile.
Oil Springs Tile & Cement Co.	Oil Springs	Tile.
Ord, John A.	Guelph, R.R. No. 3	Tile.
Pfaff, W. E.	Hensall	Blocks and Tile.
Philp, Wm.	Port Perry, R.R. No. 4.	Tile.
Schmidt, J. T.	St. Jacobs	Brick, Blocks and Tile.
Schram, A. J.	Camlachie	Tile.
Smith, A. G. C.	Acton	Blocks and Tile.
Taylor & Hall	Peterboro	Blocks and Tile.
Webster Construction Co., Limited	London	Tile.
Williams, E. J.	Wheatley	Blocks and Tile.
Wyatt, W. J.	Cottam	Blocks and Tile.

Sand and Gravel

For making and repairing roads, for concrete work and building purposes generally, sand and gravel are annually raised in large quantities. Special varieties of sand, such as those used for moulding in foundries or for glass-making, are also in demand. The glacial action which in past ages determined the form and nature of the present surface of the Province resulted in the deposition of innumerable accumulations of detrital material, which is now found so useful in the economy of everyday life. In certain parts, such as counties in the extreme southwest part of the peninsula, sand and gravel are less abundant and dearer. With regard to the Province as a whole, the cost of sand and gravel largely depends upon the cost of labour and transportation. A considerable quantity of these materials is taken

from the beds of the great lakes and boundary rivers, much of which is exported to lake ports south of the line. Licenses authorizing such removal are issued by the Department of Lands, Forests and Mines on a royalty basis, the charges varying from three to twelve cents per cubic yard. From this source the receipts for the fiscal year ending October 31, 1917, were $28,372.93.

In view of the importance of sand and gravel, an investigation into these resources has been begun by the Bureau. Auguste Ledoux, Professor of Mineralogy in the University of Brussels, Belgium, is now carrying on this work, and the first instalment of the results of his labours is printed as Part II of this report under the title "Sands and Gravels Deposits of Southern Ontario." It is intended to continue the investigation next year and to include in it the deposits of the newer parts of the Province in so far as they are accessible to examination.

Returns have been received by the Bureau from 129 firms or individuals who operated sand or gravel pits or who dredged for these materials in 1917. Many operations of this kind were on a small scale and carried on only at intervals. Owing doubtless to the curtailment of operations on public works, the output of sand and gravel was somewhat less in 1917 than in 1916, the quantity raised being 1,187,973 cubic yards and the value $431,597, as against 1,265,973 cubic yards worth $470,963 in 1916. Following is a list of sand and gravel operators who removed 1,000 cubic yards or more during the year:—

SAND AND GRAVEL OPERATORS, 1917.

Name of Owner or Company.	Material.	Address.
Armstrong Supply Co., The, Limited	Gravel	Hamilton, 106, Dunsmere Ave.
Ashton, Thos.	Sand	Toronto, 1354 Queen St. E.
*Barnes, William	Sand	Hamilton, 132 Blake St.
†Barton Sand & Gravel Co., The, Limited	Sand and Gravel	Bartonville.
Cadwell Dredging Co., Limited	Sand and Gravel	Windsor.
Cameron Steamship Co.	Gravel	Detroit, Mich.
Canadian Steel Corporation, Limited	Gravel	Ojibway.
Canadian Towing & Wrecking Co., Limited	Sand and Gravel	Port Arthur.
Chapman, Walter	Gravel	Uxbridge.
Chatham, Wallaceburg & Lake Erie Railway Co.	Gravel	Chatham.
Chippawa River Sand & Gravel Co.	Gravel	Chippawa.
Cleary & Annable	Gravel	Mille Roches.
Constructing & Paving Co. of Ontario, Limited	Sand and Gravel	Toronto, 708 Confed. Life Bldg.
Creeper, John	Sand and Gravel	Belleville, R.R. 5.
Crow, H. E.	Sand and Gravel	Chatham, 30 Emma St.
Empire Limestone Co.	Sand	Buffalo, N.Y., 19 Hudson St.
Empire Sand & Gravel Co., Limited	Sand	Weston.
Fonthill Gravel Co.	Sand	Thorold, P.O. Box 655.
*Gillespie, Thos. M.	Sand	Perth, P.O. Box 16.

* Moulding sand producers.
† Washing and screening plants.

SAND AND GRAVEL OPERATORS, 1917.—*Continued.*

Name of Owner or Company.	Material	Address.
Godson Contracting Co., Limited	Sand and Gravel..	Toronto, 72 Queen St. E.
Goodale, Emerson	Sand and Gravel..	Hamilton, 98 Aikman Ave.
Hamilton, J. C.	Sand	Pembroke.
†Hamilton Sand & Gravel, Limited	Sand and Gravel..	Hamilton, 37½ McNab St.
Hansen, H. C.	Sand and Gravel..	Cleveland, O., 7325 Clinton Ave.
Hope Township, Municipality of	Sand and Gravel..	Port Hope, R.R. 1.
Karr & Rose	Gravel	Petrolia.
Kelley Island Lime & Transport Co., Ltd.	Sand	Sandusky, Ohio.
Kerr, John, Estate of	Sand and Gravel..	Petrolia.
Kingston Sand & Gravel Co.	Sand	Kingston, R.R. 5.
Lindsay, Corporation of	Sand	Lindsay.
Lyons Fuel & Supply Co., Limited	Gravel	Steelton.
McMurray, Geo.	Sand and Gravel..	London.
McPhail & Wright Construction Co., Limited	Sand	Sault Ste. Marie.
Mallory, Wm. B.	Sand and Gravel..	Sebringville, R.R. 1.
*Maple Sand, Gravel and Brick Co., Limited	Sand and Gravel..	Toronto, 178 Spadina Ave.
Morrison, J. H. I.	Sand and Gravel..	Brockville.
Ollman Bros.	Sand	Hamilton, Macklin St.
Oneida Lime Co., Limited	Glass Sand	Buffalo, N.Y., 406 Erie Co. Bldg.
Ontario Malleable Iron Co., Limited	Sand	Oshawa.
Ontario Sand Company	Sand and Gravel..	Niagara Falls.
Ponsford, A. E.	Sand and Gravel..	St. Thomas, 605 Talbot St.
Porter, Thompson	Sand and Gravel..	Mount Dennis, 866 Weston Rd.
*Quigley, O. E.	Moulding and Core Sand	Hamilton.
Rideau Canal Supply Co.	Sand	Ottawa.
Robinson, A.	Sand and Gravel..	Lindsay.
Roesand Company, Limited	Sand and Gravel..	Erin.
Sand and Supplies, Limited	Sand and Gravel..	Toronto, 103 Bay St.
Sleemon, Philip	Gravel	Port Hope, R.R. 1.
Smith, J. W.	Gravel	Leamington.
Soo Dredging and Construction Co., Limited	Gravel	Sault Ste. Marie.
Soo Dredging and Towing Co.	Gravel	Sault Ste. Marie.
Stamford Sand Co.	Sand	Niagara Falls, 268 Victoria Ave.
Standard Gravel Co., Limited	Gravel	Niagara Falls, 52 Erie Ave.
Stothart, J.	Sand and Gravel..	Peterboro, R.R. 6.
Thomas, W. H.	Gravel	Oshawa.
Tombling, W. J.	Sand and Gravel..	Ottawa.
Twin City Tug Line	Sand	Port Arthur, P.O. Box 42.
Union Stock Yards, Limited	Sand and Gravel..	Toronto.
United Fuel and Supply Co.	Gravel	Detroit, Mich.
Windsor, Essex & Lake Shore Rapid Railway Co..	Sand and Gravel..	Kingsville.
Windsor Sand & Gravel Co., The, Limited	Sand and Gravel..	Walkerville.
Wood, J. T.	Sand and Gravel..	Exeter.
York Sand and Gravel Co., Limited	Sand and Gravel..	Toronto, 445 Gladstone Ave.

* Moulding sand producers.
† Washing and screening plants.
** Screening plant.

Stone

There is no lack of stone in Ontario, and there are many kinds. Granite, gneiss, trap, sandstone, limestone, dolomite, quartz, marble, all may be had in abundance, according to locality. In southwestern Ontario the sedimentary formations furnish first-class building material both in sandstone and limestone, and a plentiful supply of the latter for the multifarious uses to which it is put—lime-making, as a fertilizer, in the chemical industry, etc., while granite and trap for street and road-making can be quarried in eastern and northern Ontario. Quartz and quartzite occur, especially on the north shore of Lake Huron and the islands adjoining, and beds of variegated and beautiful marble ranging in colour from white to mauve and red exist in some of the eastern counties.

The total production of stone, excluding quartz, which is given separately, had a value of $939,052, as against $755,312 in 1916.

Stone Production

Classified according to variety rather than uses, the quarry products of the Province for 1917, together with comparative values for the two preceding years, were as follows:—

——	Limestone.	Sandstone.	Trap.	Granite.	Marble.	Quartz
	$	$	$	$	$	$
1915.....	587,000	5,500	32,100	15,500	10,600	142,354
1916.....	625,628	14,268	91,762	23,655	.....	223,514
1917.....	728,975	115,932	70,570	25,575	.....	358,674

Below are given the names of quarry operators reporting a production for 1917, classified according to product:—

LIMESTONE AND SANDSTONE QUARRIES, 1917.

Name of Owner, Firm or Company.	Location.	Kind of Stone.
Beachville White Lime Co, Limited.....	Beachville	Limestone.
Bergin, Patrick	Napanee	do
Britnell & Co., Limited	Burnt River	do
Canada Crushed Stone Corporation, Limited..	Dundas	Limestone and Sandstone.
Canadian Towing and Wrecking Co., Limited..	Port Arthur	Rubble.
Contractors' Supply Co., Limited	Orangeville	Crushed Limestone.
Cook, J. S.	Wiarton	Limestone.
Crushed Stone, Limited	Kirkfield	Crushed Limestone.
Farr, Mrs. C. C.	Haileybury	Limestone.
Hagersville Crushed Stone Co., Limited	Hagersville	do
Hamilton, Corporation of	Hamilton	do, crushed.
Henderson Farmers' Lime Co.	Woodstock	do, ground.
Kingston, Corporation of	Kingston	do, crushed.

LIMESTONE AND SANDSTONE QUARRIES, 1917.—*Continued.*

Name of Owner, Firm or Company.	Location.	Kind of Stone.
Longford Quarry Co., Limited	Longford Mills	Limestone.
MacDonald, Jos. H.	Point Anne	do
Markus, Wm., Ltd.	Pembroke	do
Michigan Central Railway	Hagersville	do
Oliver-Rogers Stone Co., Limited, The	Owen Sound	do
Ontario Rock Co., Limited	Rossmore	do
Ontario Stone Corporation, Limited	Uhthoff	do
Perkins, Geo. A.	Owen Sound	do
Point Anne Quarries, Limited	Point Anne	do
Queenston Quarry Co., Limited	St. Davids	do
Reid, C. F.	Odessa	do
Robertson, D., & Company, Limited	Milton	Sandstone.
Robillard, H., & Son	Ottawa	Limestone.
Roddy & Monk	Kingston	do
Solvay Process Co., The	Amherstburg	do
St. Marys Horse Shoe Quarry, Limited	St. Marys	do
Standard Crushed Stone Company, Limited	St. Davids and Windmill Point	do
Standard White Lime Co., Limited	Beachville, Guelph and St. Marys	do
Thibault, Adelard	Billings Bridge	do
Walker Bros.	Thorold	do
Welland County Lime Works Co., Limited	Port Colborne	do
Wentworth Quarry Co., Limited	Vinemount	do

GRANITE AND TRAP QUARRIES, 1917.

Name of Owner, Firm or Company.	Location.	Kind of Stone.
Brown, Robert	Lyndhurst	Granite.
Bruce Mines Trap Rock Co., Limited	Bruce Mines	Trap.
Gordon Granite Co., D. J.	Gananoque	Granite Blocks and Monuments.
Horne, Wm.	Ignace and Butler	Granite Blocks and Monuments.
National Potash Corporation, Limited	Gravenhurst	Crushed Granite.
Ontario Rock Co., Limited	Preneveau	Trap.

Actinolite

Some 120 tons of actinolite from stocks on hand were shipped by the Actinolite Mining Company, Limited, whose mine is situated at Actinolite, in the county of Hastings. The product was valued at $1,320, and was intended for use in the manufacture of roofing material.

Asbestos

From a deposit in the township of Deloro, near Porcupine, the Slade-Forbes Asbestos Company shipped 10 tons of asbestos valued at $2,150. A total of 800 tons of asbestos rock was mined during the season.

Barite

In the township of Langmuir, Porcupine Mining Division, the Premier Langmuir Mines, Limited, has been developing a barite property about 30 miles from the Timiskaming and Northern Ontario Railway. The vein is a large one and carries a little silver. A mill for grinding the barite and preparing it for market is being erected and will shortly be in operation. Mr. J. A. McIntosh, of Toronto, is president of the company.

Barite occurrences have long been known to exist in eastern Ontario, principally in the counties of Frontenac, Lanark, and Hastings, also on McKellar Island, Lake Superior, and on the north shore of that lake. Some of these have been worked, but there has been little or no production of late years. More recently, deposits have been found in the Fort Matachewan gold area, some of which are described by A. G. Burrows.[1] These comprise the Biederman claim, in Cairo

Premier Langmuir Mines, Ltd., Plant, fall of 1917. Narrow gauge track from 2nd vein and also to dock ½ mile distant on Night Hawk river.

township, and a deposit near Yarrow lake, in Yarrow township. Another deposit has recently been reported from the township of Lawson.

Barite (or barytes) is a heavy white mineral, sometimes coloured by impurities, having the composition $BaSO_4$. It may be granular, or in masses of wedge-edged crystals, and occurs in veins in limestones and sandstones, also associated with lead or other ores. White bleached and floated ground barite is used in ready-mixed paints, in making rubber goods, and in stiff, heavy cardboards and papers. In the intermediate form of "lithopone," a growing use is found for barite in the preparation of "flat" wall paints, in rubber manufactures, and also in enamel and calcimine. A variety of barium chemicals, such as the chlorate, chloride, nitrate, etc., serve a number of uses: the chlorate and nitrate in pyrotechnics, the chloride as a water softener, in the purification of table salt, etc. Barium monoxide, and

[1] Bulletin No. 34, Ont. Bur. Min., 1918, pp. 27-8, The Matachewan Gold Area, republished in this Report.

dioxide have also their uses. As "blanc-fixe" or permanent white, barite is extensively used as an adulterant of white lead, also in making putty.

A barium industry is rapidly developing in the United States, the principal deposits there being in the States of Georgia, Missouri, and Tennessee. The native article has already taken the place of imports from Germany, which before the war largely supplied the wants of eastern manufacturers, coming in as crude by cheap ocean transportation. Crude barite in 1916 was produced in the United States to the extent of 222,000 short tons, valued at $1,011,000, or about $5 per ton. The value of the domestic barium products was upwards of $8,500,000.

Corundum

Mining was continuous throughout the year at the property of the Manufacturers' Corundum Company, Limited, Jewellville, but as the ore can only be hauled

Premier Langmuir Mines, Ltd., showing 6-foot barite vein, summer of 1917.

out over the winter roads, the concentrating mill ran only from January 21 to July 25. The quantity of corundum ore mined was 6,799 tons, and of grain corundum produced 188 tons, valued at $31,213. The employees were 46 in number, and the wages paid them amounted to $33,817.

Feldspar

The production last year was 18,334 tons, an increase of 5,369 tons over that of 1916. The value was $81,802, or $4.45 per ton, compared with $3.25. The principal site of the feldspar industry is on the line of the Kingston and Pembroke railway, in the county of Frontenac. Feldspars, Limited, and Feldspar Quarries, Limited, the former at Hartington, and the latter in the township of Portland, were the leading producers. Eureka Flint and Spar Company also quarried considerable spar at Verona and exported it to Trenton, N.J. The output has hitherto found a market as crude rock in the pottery manufacturing trade in New Jersey

and Ohio, but the product of the largest mine is at the present time being entirely used in making insulating material for use in the U.S. army. There is now a grinding mill at Parham, which supplies the Canadian trade with ground spar. The Canada Feldspar Corporation, Limited, near Fermoy, and Stephen Fitzpatrick and Company, in the township of Herschel, quarried and shipped small quantities of feldspar. The last-named company did mostly development work, and claims to have exposed three varieties of spar, namely, the red or pink potash variety, white spar, and greenish soda spar. The National Potash Corporation, Limited, Gravenhurst, has a stone-crushing plant at Muskoka Wharf, and is installing a plant with the view of extracting potash from the feldspar which occurs on the property. The works are not yet in operation.

The companies producing feldspar in 1917 were as follows:—

FELDSPAR PRODUCERS, 1917.

Name.	Location of Deposit	P.O. Address.
Canada Feldspar Corporation, Limited....	near Verona	Toronto, 168 Madison Ave.
Eureka Flint & Spar Co., The	Verona	Trenton, N.J.
Feldspars, Limited	Bedford tp.	Hartington, R.R. No. 1.
Feldspar Quarries, Limited	Portland tp.	Toronto, 33 Richmond St. W.
Fitzpatrick & Co., Stephen	Herschel tp.	Toronto, 79 Adelaide St. E.
Kingston Feldspar & Mining Co.	Verona and Godfrey	Kingston.
National Potash Corporation, Limited ...	Gravenhurst	Toronto, 178 Spadina Ave.

Fluorspar

A little fluorspar has in the past from time to time been extracted from the deposits known to exist near Madoc, in the county of Hastings, but the demand was never great, and this branch of the mining industry could scarcely be said to have an existence. The war has changed this, and the call for fluorspar, which began to be heard in 1916, continued into 1917 even more loudly. Previous to 1916 there had been no production since 1911, when 30 tons were reported as extracted, valued at $200. In 1916 shipments were 1,283 tons, and in 1917, 1,327 tons. The selling price rose concurrently. In 1911 shipments were valued at $6.66 per ton, in 1916 at $7.90 per ton, and last year at $15.13. The demand came from steel manufacturers for use as a flux.

The veins of fluorspar worked last year were near Moira lake, in the townships of Madoc and Huntingdon, and a fuller account of the deposits, together with a map showing their exact locality, will be found on a later page in the report of the Chief Inspector of Mines. The number of employees was 56, and the wages paid for labour $29,582.

Fluorspar has recently been found in quartz veins in the townships of Alma and Cairo, near Fort Matachewan, Northern Ontario. The deposits are small. They are described by A. G. Burrows in his report on the Fort Matachewan gold

area.[1] Here the mineral is of a purple colour, while in the Madoc deposits the tint is a sea-green or white.

Following were the operating individuals and firms:—

FLUORSPAR SHIPPERS, 1917.

Name.	Location.	Address.
Cross & Wellington	Lot 11, Con. XIII, Huntingdon	Madoc.
Gillen & Henderson	Lot 7, Con., XIII, Huntingdon.	Madoc.
Herrington, Herbert S.	Lot 2, Con. XII, Huntingdon..	Madoc.
Mineral Products, Limited	Lot 2, Con. III, Madoc	Madoc.
O'Reilly Company	Lot 6, Con. I, Madoc	Madoc.
Wallbridge, Mrs. Jane	Lot 4, Con. I, Madoc	Madoc.
Wellington & Munro	Lot 13, Con. XII, Huntingdon .	Madoc.
	Lot 1, Con. I, Madoc	Madoc.

Graphite

The output of refined graphite in 1917 was somewhat less than in 1916, being 3,173 tons, as against 3,416. The valuation, $210,018, was also slightly less, the average per ton being $66.18, as compared with $73.06. Black Donald Graphite Company, Limited, and Globe Graphite Mining and Refining Company, Limited, were the two operating companies. The mine and mill of the former are at Whitefish lake, Brougham township, and of the latter at Port Elmsley, on the Rideau canal. Employees in the mines and works numbered 156, to whom wages amounting to $120,083 were paid.

The uses of graphite are numerous. They include the manufacture of lubricants, lead pencils, foundry facings, stove polish, paint, etc. Crucibles and high grade lubricants are made from the flake variety, which commands the highest price; for other uses the amorphous variety is employed. Hitherto there has been a considerable demand for crystalline flake for the manufacture of crucibles to be used in making special grades of steel, and the demand was chiefly for the Ceylon product, importation of which has been cut off. However, the tremendous requirements of the war for steel have brought about changes in the steel trade. The crucible method of manufacture, with its small units and limited capacity has been side-tracked, and this has lessened the demand for the higher grades of graphite. Moreover, the necessity for war material is imperious, and ordinary industrial needs are forced to take second place. In consequence, foundry operations other than munitions have been much curtailed, and a smaller quantity of the lower grades for facing purposes suffices. These conditions have had their natural effect upon the graphite industry, especially since the beginning of 1918, and the present outlook is for a diminishing production.

[1] Bulletin No. 34, Ont. Bur. Min., 1918, The Matachewan Gold Area, p. 25.

Following is a list of graphite operators:—

GRAPHITE OPERATORS, 1917.

Company.	Location of Mine.	P.O. Address.
Allan, J. G.	near Denbigh	Hamilton, 27 Hillcrest Avenue.
Beidelman, J. C.	Lyndoch tp.	Montreal, P.Q., 29 Cote des Neiges Road.
Black Donald Graphite Co., Limited	Brougham tp.	Calabogie.
National Graphite, Limited	Monteagle tp.	Toronto, 402 Lumsden Building.
The Globe Graphite Mining and Refining Co., Limited	Port Elmsley	Syracuse, N.Y., U.S.A., 410 Dillaye Building.
Tonkin-du Pont Graphite Co., Limited	Maynooth†	Phoenixville, Pa., U.S.A., 309 Church St.

* Idle in 1917. † Refinery at Wilberforce.

Gypsum

The production of gypsum is confined to the deposits in the valley of the Grand river, where the Caledonia mine, in Seneca township, and the Martindale mine, in Oneida township, are now owned and worked by the Ontario Gypsum Company, Limited, an amalgamation of the Alabastine Company and Crown Gypsum Company, which became effective January 1, 1917. Crushed and calcined gypsum to the extent of 48,943 tons were shipped during the year, the value of the same being $130,138. This compares with 36,668 tons, worth $116,206, in 1916. The number of employees was 70, who received as wages $59,966.

Gypsum, ground but not calcined, is employed as a retarder in Portland cement, as land plaster, as paint material, and for other minor uses. After being calcined, it is made into wall plasters of various kinds, into dental plaster, and is also sold to glass factories. It is used in this form in Portland cement. Other uses are the manufacture of statuettes and similar objects. Combined with fibrous material it is made into building blocks, for whose fire-resisting qualities much is claimed, because of the non-conducting and non-expanding properties of gypsum.

Very large beds of gypsum are found on the banks of several of the rivers running into James bay, but these are as yet too remote for utilization.

Iron Pyrites

In few departments of the mineral industry have the demands of war had so noticeable an effect as in the mining of iron pyrites. Sulphuric acid is a prime requisite in the manufacture of explosives. Prior to the war much of the sulphur required for making the acid was supplied by the sulphur deposits of Sicily, remains of the ancient volcanic forces once active in that island. The entrance of Italy into the war and the diversion and destruction of ships stopped the transatlantic exports, and the output of sulphur from the mines on the Mexican Gulf was insufficient for the requirements of the ammunition factories of the United States and Canada. This condition was doubly emphasized when in April, 1917, the United States joined the Allies. The pyrite deposits of Ontario being close at

hand and conveniently situated for water transportation, were called upon to make good a large part of the deficiency. Shipments of pyrite from this Province rose from 107,258 tons in 1914 to 145,315 tons in 1915, 175,593 tons in 1916 and 286,049 tons in 1917. The probability is that in 1918 the rate of increase will be maintained. Like practically all products, mineral and other, the price has risen materially. In 1915 the producers returned their output at a valuation of $2.43 per ton, in 1916 at $2.68 per ton, and in 1917 at $3.88. The following figures show how greatly the war has stimulated the mining of pyrite in Ontario:—

IRON PYRITES PRODUCTION, 1913 TO 1917.

Year.	Production.	Value.	Valuation per ton.
	tons	$	$
1913	71,620	171,687	2.39
1914	107,258	264,722	2.46
1915	145,315	353,498	2.43
1916	175,593	471,807	2.68
1917	286,049	1,111,264	3.88

It will thus be seen that in five years the output of iron pyrites has increased in quantity four times and in value more than six times.

The list given below enumerates the operators for 1917. The Nichols Chemical Company, Limited, was much the largest producer, from its mines at Northpines and Goudreau, the former near the junction of the Grand Trunk Pacific railway and the Fort William branch, and the latter on the line of the Algoma Central, in the Michipicoten area. The Nichols Company is the Canadian arm of the General Chemical Company of the United States. It also operates a mine and acid plant at Sulphide, Hastings county. The Rand Consolidated Syndicate is working a deposit at Goudreau. At Flower station, on the Kingston and Pembroke railway, the mine opened by T. B. Caldwell has passed under a working lease to the Grasselli Chemical Company, Limited. A quantity of ore was mined in 1917, but no shipments made.

The proportion of sulphur in the pyrite shipped from the mines varies from 31.76 to 45 per cent. The average in the shipments for last year was in the neighbourhood of 35 per cent., hence the sulphur contents would amount to upwards of 100,000 tons. This would be the equivalent of 300,000 tons of ordinary strong sulphuric acid. It is expected that about one-third of the total pyrite requirements of the United States for 1918 will be obtained in Ontario.

Notwithstanding the comparative abundance of pyrite in Ontario, considerable quantities of elemental sulphur are yearly imported into this Province, partly for use in manufacturing sulphuric acid, but mainly to be converted into sulphurous acid needed in making wood pulp. It would seem that in northern Ontario, where the mining of pyrite and the manufacture of pulp and paper are both carried on, it should be possible to substitute the native for the imported article, and to effect economy in doing so.

The number of workmen employed in the pyrite industry was 580, of whom 209 were engaged in underground work, and 371 above ground. They were paid wages totalling $583,819.

IRON PYRITE SHIPPERS, 1917.

Name of Owner, Firm or Company.	Location or Name of Mine.	P.O. Address of Manager, etc.
Algoma Steel Corporation, Limited	Helen	Sault Ste. Marie.
Canadian Sulphur Ore Company, Limited.	Queensboro	Toronto, Crown Office Building.
Nichols Chemical Company, Limited (*a*)	Goudreau	Goudreau.
Nichols Chemical Company, Limited	Sulphide	Sulphide.
Nichols Chemical Company, Limited (*b*)	Vermilion Lake	Northpines.
Rand Consolidated Syndicate	Goudreau	Buffalo, N.Y., 853 Ellicott Square.

(*a*) Formerly known as The Madoc Mining Company.
(*b*) Formerly known as The Northern Pyrites Company, Limited.

Mica

During 1917 shipments of mica were made by producers of both rough-cobbed and thumb-trimmed grades. Of the former 40 tons, worth $7,100, were marketed, and of the latter 790,905 lbs., worth $85,353, or a total of 435 tons valued at $92,453.

Owing to labour scarcity, mining operations have been curtailed, but a great deal of dump material has been sorted and marketed. A shortage of mica is in prospect owing to the large demand for this material for war purposes, and also to the limited production. The Loughborough Mining Company, Limited, Kent Bros., and estate of J. M. Stoness, S. H. Orser, and A. G. Martin were among the larger producers.

There were 88 employees at work during the year, who were paid $48,490 in wages.

Shipments were made by the following during 1917:—

MICA PRODUCERS, 1917.

Name of Owner or Producer.	Location or Name of Mine.	P.O. Address of Manager, etc.
Anglin Mica Co.		Kingston.
Buck Lake Mining Co.	Loughborough tp.	Perth Road.
Fahey & Sullivan	South Crosby tp.	Elgin.
Grierson & Gallagher	North Burgess tp.	Perth, R.R. No. 5.
Kent Bros. and Estate J. M. Stoness	Bedford tp.	Kingston.
Loughborough Mining Co., Ltd.	Lacey mine	Sydenham.
McConnell, Rinaldo	North Burgess tp.	Toronto, 1002 Kent Bldg.
McLaren, W. L.	North Burgess tp.	Perth.
Martin, A. G.	Connors Mine, Portland.	Ottawa, 234 Besserer St.
Orser, S. H.	North Burgess tp.	Perth.
Sydenham Mica and Phosphate Mining Co., Limited	Loughborough tp.	Perth.
Tett & Bro., J. P.	Bedford tp.	Bedford Mills.
Waffle, W.		Westport.
Webster & Co.	North Burgess tp.	Ottawa, 274 Stewart St.

Natural Gas

The total amount of natural gas produced in Ontario during the year was 20,026 million cubic feet.

In the following table of distribution by fields, compiled by the Mine Assessor, the yield from a number of very small operators is not included.

	Million cubic ft.	
1. Welland, Haldimand, etc., field	3,760.2	or 19.2 per cent.
2. Kent field (old field)	15,229.7	77.9
3. Kent, new field (Dover Tp.)	220.7	1.1
4. Elgin	290.8	1.6
5. Lambton	44.6	0.2

The old field situated in Welland, Haldimand, Norfolk, Wentworth and Brant counties has now produced 61,132 million cubic feet. Small new pools are discovered from time to time but are not sufficient to compensate for the decline in output of the old wells, and the outlook for an increase of gas from this section is not bright. The most promising area of substantial size left for exploration is at Long Point, where drilling is now going on.

The Kent field in Romney, Tilbury and Raleigh townships has again been the mainstay of the production, and the yield from this field to the end of 1917 amounts to 81,030 million cubic feet. This is equivalent in heating value to 4,000,000 tons of coal approximately. The course of events in this field is dealt with at length below.

The new field in Dover township came into operation for the first time last year. The gas is found in the Trenton at a depth of about 3,300 feet and is associated with oil.

The Elgin field has been described at length in previous Reports, and there is nothing new to record. The production from Elgin county now amounts to 2,556.2 million cubic feet.

The Lambton field at Oil Springs has unfortunately had a short life; the production has fallen to 670.6 million cubic feet, and is rapidly declining each year.

Noteworthy events have taken place since the beginning of 1918 in the Kent county natural gas field, affecting the social and industrial life of the community. Failure of gas supply, concurring with an unusually severe winter, led to much hardship and even suffering among the many thousands of people in southwestern Ontario who have come to depend upon gas for that primal necessity of human life, fuel. The use of gas for heating and cooking purposes has become well nigh universal in the cities, towns, villages and even farms which have access to a supply. It makes no ashes and little dirt, is easy to turn on and off, and it is cheap. But an increasingly large proportion of the gas has been going to manufacturers, many of them using large quantities in the coarser and heavier industries, and getting their gas at a much lower rate than domestic consumers. The feeling has for some time been growing that natural gas should be treated as a fuel for household consumption only, and the crisis last winter led to an outcry against the manufacturing and industrial use of gas. Strong representations were made to the Government, and the Legislative Assembly with practical unanimity passed

an Act handing over the control of the natural gas supply to the Ontario Railway and Municipal Board.

The Natural Gas Act, 1918

G. R. Mickle, Mine Assessor, who supervises the inspection of gas and oil wells in the Province on behalf of the Department, and whose duties have made him familiar with the gas situation deals with it as follows:—

The most important event in the year affecting the natural gas industry was the failure of the Kent gas field to respond to the ever increasing and exorbitant demands made on it, and the consequent break-down of the whole system, causing a shortage of gas in many homes, with the inevitable suffering this entails. The government was petitioned to bring the matter before the Ontario Railway and Municipal Board. This was done, and a sitting of the Board was held in Chatham about the middle of January. In consequence of the Board's report the Natural Gas Act of 1918 was passed. This Act places the regulation of the natural gas output in the hands of the Ontario Railway and Municipal Board. Under the powers conferred by the Act the Board ordered natural gas to be cut off from a number of industries till the 1st of April. This Order was made about the middle of February. From 1st April to 1st July industrial consumers with a few exceptions were allowed to use the same amount of gas as they had consumed during the same months last year. On 1st July a general order was issued by the Board largely confining the use of gas to domestic purposes, and greatly restricting its industrial use. The only use of natural gas for power permitted by this order is for the highly economical gas engine, and in methods and appliances which ordinarily are served with artificial gas, which is nowhere cheap. The amount that may be so used by any company is limited to 5,000,000 feet per year. At the same time, pending changes during the transition period, permits were issued by the Board for a supply of gas to carry on operations while plants are being reconstructed to use other fuel.

Assuming the policy outlined to be continued, the result must be a prolongation of the life of the field for the benefit of the domestic consumers now using gas. With the high prices now prevailing for the most convenient solid domestic fuel, and the difficulty of securing hard coal even at $11.00 per ton, this is certainly a great boon to all the communities now served with natural gas.

Difficulties in Regulation and Public Control

The history of the Kent gas field does not differ essentially from that of any other field yielding gas. The difficulty is in the nature of the product, which is unlike anything else with which we are accustomed to deal. The essential difference, and the root of all the trouble, lies in the fact that there is no physical means by which the holder of one piece of land can be prevented from drawing gas from adjoining territory. If the holder of a lease could be assured of his ability to draw off the gas underlying his leases, which rightfully belongs to him, and to utilize it in the most economical manner, there would be no excuse for entering into a crazy competition to exhaust the field as quickly as possible, and sell the gas at any price rather than let a competitor have it. This condition inevitably leads to some public control of production and distribution as the only possible solution of the difficulty. There does not seem to be any insurmountable obstacle in the way of determining what proportion of the total amount of gas in reserve underlies any particular set of leases, and consequently what percentage of the total production permissible should be allotted to any one company.

Boyle's Law and Natural Gas

This law, if properly understood and followed, is a certain guide in planning the rate of production that should be permitted in any gas field. The rate of production should, of course, be governed by the amount of gas which exists in any field, of which Boyle's law is a sure means of measure. The expression so often used of the "uncertainty" of the gas supply is absurd when the rock pressures and production are studied in the light of this law. So far from being uncertain, the amount of gas existing in a field can be calculated within reasonably close limits years before the point of exhaustion is reached. As this law is the most important thing in connection with natural gas and has been disregarded, it seems worth while to explain it at some length, and show its application in planning a rational scale of production from any field. Considering that Boyle's discovery of the law that bears his name was announced in 1660—over 250 years ago—and has appeared in every text-book on physics for generations, it is surprising that it is so generally ignored. Boyle called his discovery the "Doctrine of the Spring and Weight of the Air," the spring, or pressure as we would now say, being due to the weight. In his work called "The Defence of the Doctrine of the Spring and Weight of the Air," the following passage, which seems

to forecast the general attitude towards the natural gas question, occurs: "I see no cause to despair that, whether or no my writings be protected, the truths they hold forth will in time, in spite of opposition, establish themselves in the minds of men, as the circulation of the blood, and other formerly much contested truths, have already done."

It has been a long wait.

Let us imagine that a tank or container is constructed of glass as illustrated in fig. 1 with dimensions of 10 ft. by 10 ft. by 10 ft., so that it contains exactly 1,000 cubic feet. Suppose this to be first filled with water, and provided with a pipe to form an inlet for gas and another pipe as an outlet for the water. Now allow natural gas or air or any other gas to enter slowly and displace the water. In fig. 1 the point of time is shown when the water is about half gone. Allow the gas to flow in slowly till the water is all gone, then instantly close both inlet and outlet. The tank will of course contain exactly 1,000 cubic feet of natural gas, and the pressure gauge will read zero, although there is a pressure in the tank exactly equal to the atmospheric pressure which the gauge does not record. This is shown in fig. 2. This atmospheric pressure is known to be approximately 15 lbs. to the square inch, and in considering the relation between volume and pressure we should start from the absolute zero, or add 15 lbs. approximately to the gauge reading. Thus if we wish to calculate the difference in volume between gas at atmospheric pressure or zero on the gauge, and 6 oz. on

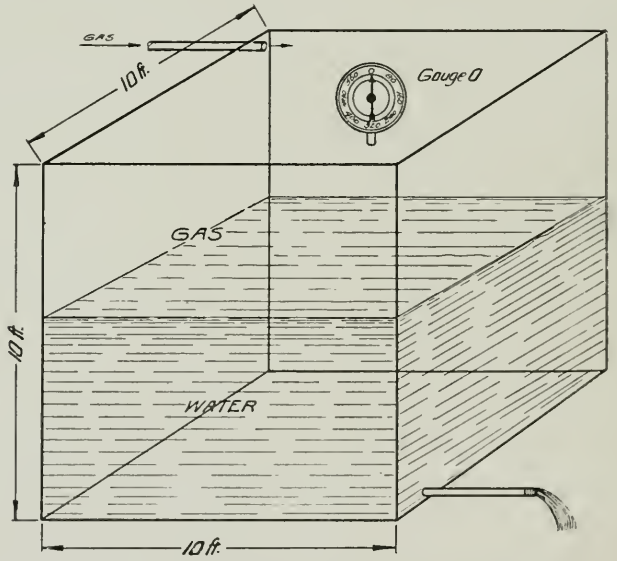


Fig. 1.—Diagram showing method of replacement of water by gas.

the gauge, add 15 lbs to each, then, reducing both to ounces, we have respectively pressures of 240 oz. and 246 oz., and there will be 2.5 per cent. more gas at the 6 oz. gauge reading than there was at the zero reading, as will be seen later on.

Coming to fig. 3, the gas has been passed into the tank till the gauge reads 15 lbs. or 30 lbs. above the absolute zero; that is, there is a pressure of two atmospheres above zero, and there will be exactly 2,000 cubic feet of gas in the tank. Therefore the pressure counting from the zero point has been doubled, and the volume occupied by the first 1,000 cubic feet in the tank has been reduced to one-half. Boyle's law is often expressed in this way: pv = constant, that is, where p = pressure and v = volume, the product of the two is always the same. The original 1,000 cubic feet is compressed into one-half the space it occupied at zero gauge or atmospheric pressure, and so on. Each increase in pressure of an atmosphere means that an amount of gas equal to the volume of the container or tank, in this case 1,000 cubic feet, has been added. Fig. 4 shows the tank with a gauge reading of 590 lbs., or approximately 40 atmospheres, and consequently the tank will contain 40,000 cubic feet of gas. This was the rock pressure that originally existed in the Kent field. And it would make no difference if, instead of having one clear space of exactly 1,000 cubic feet, the tank had been made larger and then gravel and sand thrown in till the aggregate pore space equalled 1,000 cubic feet.

The tank, having been filled, can be emptied in exactly the same way; every atmosphere drop in pressure means that 1,000 feet have been drawn off. Fig. 5 illustrates the state

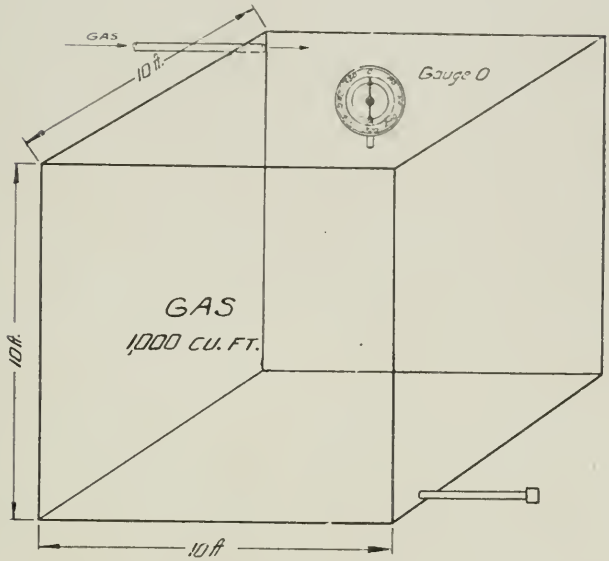


Fig. 2.—Diagram shows condition at instant all water is replaced.

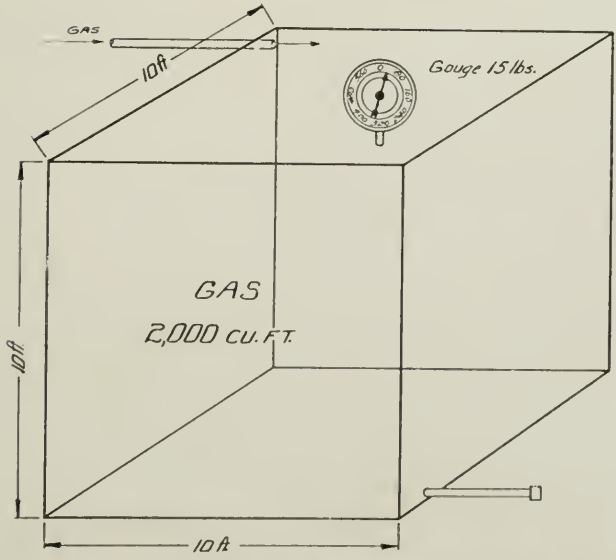


Fig. 3.—Pressure in tank now two atmospheres above absolute zero, or 15 lbs. on gauge.

of affairs existing at the present time (1st June, 1918) in the Kent field when, as explained below, the average gauge pressure was found to be 320 lbs, or 22 atmospheres approximately.

Turning now to the gas field, let us regard it, as it should be regarded, as a container or tank, and not as some mysterious geological anticlinal structure. We have not one solid chamber full of gas, but a condition resembling the case imagined above, namely, a tank of dimensions of several thousand cubic feet filled with sand and gravel to such an extent that finally the aggregate volume of the spaces between the sand and gravel is equal to 1,000 cubic feet. And in this field tank, instead of one pressure gauge we have a gauge on each well, of which there are about 300 distributed all over the field, so that the average pressure is capable of close estimation. According to Boyle's law, for each increase or decrease of pressure of one atmosphere in the imaginary tank, and counting from the absolute zero, 1,000 cubic feet have been added to or drawn from the tank. In an exactly similar way, a loss of one atmosphere in pressure means a loss in our field tank of a certain number of cubic feet which is exactly the volume or cubical space contained in the tank that might be occupied by gas. It will be seen that as the gas is drawn from the field there is a certain production of gas for each atmosphere drop in pressure, which of course gives us the aggregate volume of all the pore space in the rock constituting the tank or gas field. It is evident that the proper rate of production to ensure an economical use of the supply of gas could have been estimated at least six years ago, and that the loss occasioned by increasing the production according to the demand beyond the capacity of the field was quite unnecessary.

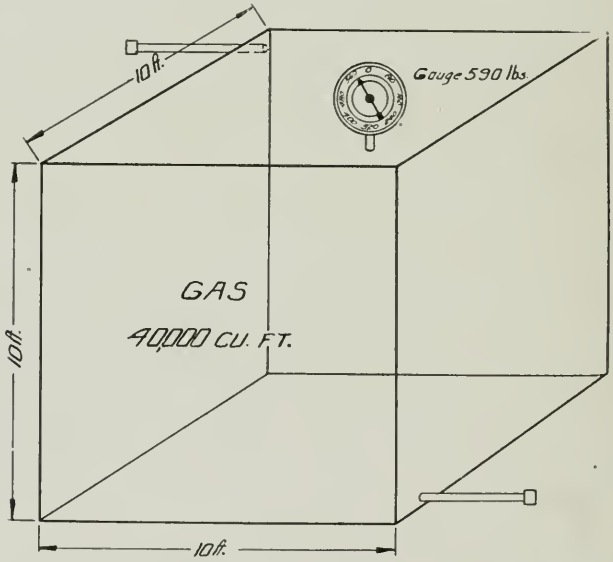


Fig. 4.—Pressure increased to 40 atmospheres.

Relation Between Drop in Pressure and Output of the Field

Up to 1st June, 1918, the production of the Kent gas field was 86,450 million cubic feet approximately, this being made up of the production to the end of 1917 of 81,030 million cubic feet, and an estimated production of 5,420 million feet from 1st January to 1st June, 1918. During this production the rock pressure dropped from 590 lbs. to 320 lbs. on 1st June, or a loss of 270 lbs. This determination of the average rock pressure was made by the writer with great care, the field being subdivided into a number of areas in which the rock pressures were fairly uniform, and a weight being given to each area proportionate to its size, and also to the average open flow capacity of the wells in each area.

This 270 lbs. drop in pressure is equivalent to 18.75 atmospheres at 14.4 lbs. per atmosphere, that being the atmospheric pressure at the altitude of the gas field. The output for each decline of one atmosphere in pressure is accordingly 4,610 million cubic feet, which is the aggregate volume of the pore space in the rock. It is naturally more easy to closely calculate the relation between the loss of pressure and the output, the more nearly the field approaches the point of exhaustion. When the pressure is down to nearly zero, and the field is abandoned, we will know exactly the relation between the two, but the knowledge will then be of little value.

For all practical purposes, however, it can be seen that the relation between decline in pressure and output, and consequently the rate of production which should be allowed, was known and published with sufficient accuracy years ago. Thus from information given in various Reports of the Bureau of Mines, it can be seen that at the end of 1912 the production from the Kent field was 23,132 million cubic feet, with a loss in pressure of about 90 lbs., or 6.2 atmospheres, or 3,730 million feet per atmosphere, or a difference of 20 per cent. from the amount finally calculated. At the end of 1913 the output was 31,108 million feet, with a loss in pressure of 8 atmospheres, or 3,888 million feet per atmosphere, a difference of 16 per cent. from the standard. Taking the year 1913 alone, which of course would give an independent check, the production was 7,976 million feet and a decline of 1.8 atmospheres, or 4,431 million feet per atmosphere, a difference of 5 per cent. from the final estimate. The output from 1913 to June, 1918, was 55,342 million feet and drop in pressure 10.75 atmospheres, or 5,148 per atmosphere, or 12 per cent. variation from the final figures.

In the case of all these estimates, previous to 1918, no special effort was made to accurately determine the rock pressure and the output at any given date, which of course would be necessary in order to establish the relation between the two. The records of production are kept according to the calendar year, whereas the most convenient time to take the rock pressures is in midsummer, when the wells are not working at the fullest capacity, consequently any of the figures given previous to 1918 are only approximations.

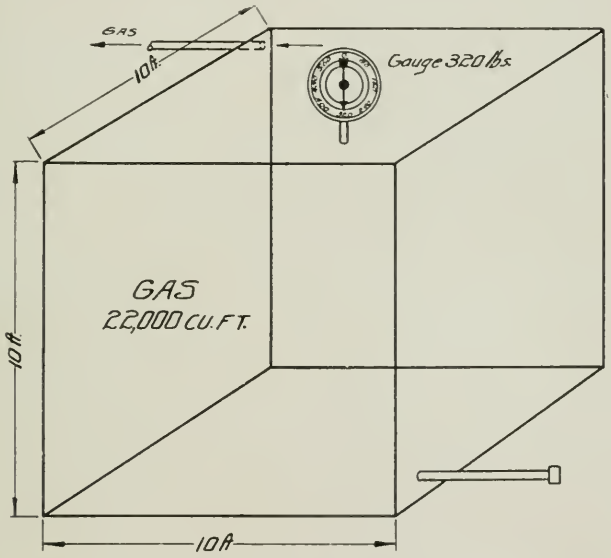


Fig. 5.—Shows condition of Kent field at present with about 22 atmospheres pressure.

At the end of 1917 pressure was assumed to be 320 lbs., which was evidently too low. As it is more convenient to have the end of the year as the accounting period, and 5,420 million cubic feet was the estimated production from January to 1st June, this corresponds to 1.17 atmospheres or 16.8 lbs. At the end of 1917, therefore, the pressure must have been 337 lbs., and not 320 as assumed in Sessional Paper No. 78 (1918) by the writer.

The Natural Limit to the Rate of Production for a Gas Field

In determining the annual output which should be allowed from any field, apart altogether from a consideration of the quantity which it is rational to permit, there is a maximum limit imposed by nature due to the physical conditions of the field, there being salt water in the rock underlying the gas, and this salt water being only kept back by the pressure of the gas and thus prevented entering the wells and ultimately cutting off the supply of the gas. Experience in the past has shown that where the production from a field has been accelerated too much, thereby reducing the pressure at each producing well, salt water comes in and finally shuts off the output of the well entirely. There is no way of calculating exactly what this rate should be, but it can be approximated from experience, and it would appear that a reduction of the pressure by one atmosphere per year is a natural limit. A loss of one atmosphere of pressure means that the production is exactly equal to the total volume of all the

incalculable number of pores which constitute the field tank, and consequently involves great motion. When it is considered that the gas is stored in countless millions of minute pores, and must find its way slowly owing to the great friction through vast numbers of the smallest openings, it can be seen that time is required to equalize the pressures throughout the field and not allow a very low pressure at the well which would permit the entrance of water. With a purely domestic consumption it would be possible to give the wells a rest in the summer months when the consumption is for cooking only and the output consequently very small—only from 4 to 5 per cent. altogether of the total annual domestic consumption being used in the months of July and August.

The history of the Essex gas field, which is only 20 miles from the Kent field, the gas being exactly the same in composition and therefore almost certainly having come from the same source, is instructive in this respect and should furnish sufficient warning. The Essex field was discovered in 1889, the depth of the gas being about 1,000 feet and the rock pressure 500 lbs. In the Kent field the depth of the wells is about 1,300 feet and original pressure 590 lbs. In 1900 the pressure was reduced to between 325 and 350 lbs.[1], or a maximum drop of about 12 atmospheres in 11 years. In 1901 about three-quarters of the wells were full of salt water.[2] The production in 1902 was much smaller than in 1901.[3] The export was shut off towards the end of 1901 and the field was practically abandoned in 1903.[4] The records of production are unfortunately very incomplete, but about 22,500 million cubic feet from this field appear to have been utilized,[5] and as there was an enormous waste in the early days of the field, probably not less than 30,000 million cubic feet came from this area. Of this all but about 3,000 million feet were produced before 1901, or a production of not less than 27,000 million was accompanied by a drop of 12 atmospheres pressure or 2,250 million feet per atmosphere. Assuming this field could have been operated down to 50 lbs. pressure, or a further deduction of 287 lbs. or 20 atmospheres, it should have produced 45 000 million feet after 1900, instead of about 3,000 million. It has been shown already that in the Kent field a production of 4,610 million feet corresponded to a loss of 1 atmosphere in pressure. This will be as nearly as can be determined the purely domestic consumption assuming the order of the Ontario Railway and Municipal Board is carried out. It was shown above that the total output up to June, 1918, was about 86,000 million, and if the field can be operated down to 50 lbs. pressure (the Welland field is being operated below 50 lbs.) the same amount must be left as has been produced up to that time.

It would be a great calamity if the same thing happened in the Kent as in the Essex field, and in the public interest measures should be taken to avert the threatened destruction of the supply. The estimated consumption for the first half only of 1918 is 5,880 million cubic feet, the restriction as to industrial use not coming generally into force till 1st of July. The distribution of the consumption for 1917 was 9,400 million cubic feet for industrial users and 5,829 million for all other consumers. Under the order[6] of the Board referred to above there should ultimately be an estimated saving among the non-industrial consumers of 1,457 million cubic feet per year, making the actual domestic consumption 4,372 million feet, to which must be added an estimated industrial consumption for the special purposes mentioned in the order of about 300 million feet, or a total in all of 4,672 million cubic feet. In tabular form the consumption based on the results for 1917 is as shown below:—

	Million cubic feet.
Estimated total industrial consumption, 1917	9,400
All other consumers (non-industrial)	5,829
Total	15,229
Estimated industrial consumption, January-July, 1918	2,260
Estimated non-industrial consumption, January-July, 1918	3,620
Total consumption, 6 months	5,880

[1] Ont. Bur. of Mines Rep., Vol. X, p. 19.
[2] Ont. Bur. of Mines Rep., Vol. XI, p. 43.
[3] Ont. Bur. of Mines Rep., Vol. XII, p. 38.
[4] Ont. Bur. of Mines Rep., Vol. XIII, p. 22.
[5] Ont. Bur. of Mines Rep., Vol. XXV, p. 39.
[6] A later order of the Board (August 30, 1918) permits the use of natural gas until June 1, 1919, in hospitals, sanitariums, hotels, restaurants, offices, stores, schools, churches, halls and other public buildings, also libraries, clubs, and theatres, where the same was in use during the winter of 1917-18, subject to the condition that the consumption shall not exceed that for the corresponding period of last winter. Much of the estimated saving shown above will therefore for the coming season be eliminated.

This represents a saving over the same period last year of 2,440 million cubic feet. The estimated consumption when the Board's order is completely in operation is as follows:—

	Million cubic feet.
Estimated saving by abolition of flat rate	100
Estimated saving by limitation of free users, etc.	47
Estimated saving by cutting off public buildings, offices, etc	1,310
Total	1,457
Non-industrial consumption, 1917	5,829
Deduct estimated saving	1,457
Estimated domestic consumption	4,372
Add estimated industrial consumption for special purposes	300
Total	4,672

Natural Gas Statistics

The following table summarizes the statistical information collected for 1917, and for purposes of comparison figures for 1916 are given also. The mileage of pipe lines for the non-producing companies which distribute natural gas is included in the total mileage of pipe line. In 1916 this item was not so included:—

	1916.	1917.
Gas wells drilled in year:		
Productive	135	121
Non-productive	38	52
Producing wells at end of year	1,802	1,905
Miles of pipe line	2,233	2,925
Workmen employed	653	780
Wages for labour	$404,039	$537,946
Gas production:		
Quantity (M. cu. ft.)	17,953,396	20,025,699
Value	$2,404,499	$3,220,123

The following producers of natural gas reported an output for 1917:—

NATURAL GAS PRODUCERS, 1917.

Name of Person or Company.	Producing Wells, Dec. 31, 1917.	Township.	P.O. Address of Manager, etc.
Aikins, W. J.	1	Onondaga	Dunnville.
Aldrich Gas & Oil Co., Limited	10	Rainham	Hamilton.
Azoff Natural Gas Co., Limited	1	N. Cayuga	Canfield.
Barnard-Argue-Roth-Stearns Oil & Gas Co., Limited	1	E. Tilbury	401 Iroquois Building, Buffalo, N.Y.
Beaver Oil & Gas Co., Limited	23	Romney & E. Tilbury	Buffalo, N.Y.
Bertie Natural Gas Co., Limited	8	Bertie	Ridgeway.
Canadian Gas Co., Limited	43	Romney, Tilbury E.	1426 Dime Bank Bldg., Detroit, Mich.

NATURAL GAS PRODUCERS, 1917.—*Continued.*

Name of Person or Company.	Producing Wells, Dec. 31, 1917.	Township.	P.O. Address of Manager, etc.
Canadian Steel Foundries, Limited	8	Crowland	Thorold.
Canfield Natural Gas Co., Limited.	3	N. Cayuga	Canfield.
Chippawa Development Co., Ltd...	7	Willoughby	Chippawa.
Chippawa Oil and Gas Co., Limited	42	Caistor, Canboro and Cayuga	Tavistock.
Coleman, J. A.	4	Wainfleet	Wellandport.
Commonwealth Oil & Gas Co., Ltd.	2	Onondaga	240 King St. E., Hamilton.
Crystal Oil & Gas Co., Ltd.	1	Onondaga	Paris.
Danskin, D.	1	Brantford	Cainsville.
Darling Road Co-operative Gas Co.	6	Canboro, N. Cayuga	Canfield.
Deagle, John	1	Onondaga	Middleport.
Diener Gas & Mfg. Co., Ltd.	1	Canboro	Dunnville, R.R. No. 5.
Dominion Natural Gas Co., Ltd....	742	Lincoln, Wentworth, Elgin, Norfolk and Haldimand (counties)	842 Marine Bank Bldg., Buffalo, N.Y.
Douglas, W. A.	1	Onondaga	Caledonia.
Dunn Natural Gas Co., Limited ..	27	Dunn	Dunnville.
Duxbury, Wellington	1	Walpole	Hagersville.
Eastside Gas Co., Limited	7	Sherbrooke	Lowbanks.
Emerson, Troughton & Laidlaw ..	4	Canboro	Attercliffe Station.
Empire Limestone Co.	4	Humberstone	19 Hudson Street, Buffalo, N.Y.
Fairbank, Estate of, J. H.	1	Enniskillen	Petrolia.
Fletcher, J. I.	1	Binbrook	Hannon, R.R. No. 1.
Fisherville Gas Co., Nos. 1 & 3 ...	2	Rainham	Fisherville.
Gas & Oil Co. of Springvale, Ltd..	2	Walpole	Hagersville, R.R. No. 4.
Grand River Oil & Gas Co.	2	N. Cayuga	Cayuga.
*Glenwood Natural Gas Co., Ltd....	80	Raleigh, Romney and Tilbury E.	Buffalo, N.Y.
Hager, Ham	1	Onondaga	Middleport.
Hamilton Gas & Oil Co., Limited..	3	Seneca	Hamilton.
Hendee Natural Gas Co.	6	S. Cayuga	Cayuga.
Home Natural Gas Co.	4	Oneida	Hamilton.
Hoover, D. E.	1	Rainham	Selkirk.
Industrial Natural Gas Co., Ltd...	38	Bertie, Crowland and Humberstone	Thorold.
Jones, James S.	3	Dunn	Port Maitland.
Jones, Nelson	2	Canboro, Moulton	Attercliffe Station.
Kindy Gas Co., Limited	7	Rainham	South Cayuga.
Kindy & Sons, D.	7	Rainham	Selkirk.
Kittinger Gas Co., Limited	5	Moulton	118 E. Eagle St., Buffalo, N.Y.
Kohler, May & Hoover	12	Canboro	Selkirk.
Lake Erie Developing Syndicate ..	1	Raleigh	Chatham.
Lalor, F. R.	5	Moulton	Dunnville.
Lalor & Vokes	10	Walpole	Dunnville.
Lamb, Alfred	9	Walpole	Selkirk.
Liesinger-Lembke Co.	1	Humberstone	Buffalo, N.Y.

NATURAL GAS PRODUCERS, 1917.—*Continued.*

Name of Person or Company.	Producing Wells, Dec. 31, 1917.	Township.	P.O. Address of Manager, etc.
McKillop Sons, Ltd., Kohler, May & Hoover	4	Canboro	Selkirk.
Marshall Lime & Cement Works, Jas.	15	Glanford and Seneca.	Hamilton.
Martin, Edward	3	Dunn	Dunnville.
Medina Natural Gas Co., Limited	22	Bayham	Chatham.
Mickle, Geo. T., & McKechnie, S.	5	Canboro	Ridgetown.
Midfield Natural Gas Co., Limited	7	N. Cayuga	32 Stinson St., Hamilton.
National Gas Co., Limited	72	Rainham, Seneca	119 Carrick Ave, Hamilton.
Niagara National Gas & Fuel Co., Ltd.	4	Humberstone	Fenwick.
North Shore Gas Co., Limited	14	Rainham	Merchants Bank Bldg., Hamilton.
Northwestern Gas Co., Limited	4	Brant (county)	13 Scott Block, Erie, Pa.
Oil Springs Oil & Gas Co., Ltd.	6	Enniskillen	Oil Springs.
Onondaga Oil & Gas Co., Ltd., The	6	Onondaga	Brantford.
Ontario Gypsum Co., Ltd., The	4	Seneca	Paris.
Pilkington Bros., Ltd.	5	Crowland	St. Catharines.
Port Colborne - Welland Natural Gas & Oil Co., Limited	25	Seneca, Oneida, Onondaga	Port Colborne.
Provincial Natural Gas & Fuel Co. of Ontario, Limited, The	13	Welland (county)	Niagara Falls.
Relief Gas Co., Limited	14	Gainsboro, Wainfleet.	117 Queenston Street, St. Catharines.
Richmond Gas & Oil Co., Ltd.	4	Bayham	Chatham.
Robinson Road Gas Co.	4	Canboro and Moulton	Dunnville, R.R. No. 4.
Sparham, A. F.	6	Glanford	Caledonia.
*Standard Natural Gas Co., Ltd.	45	Onondaga	Buffalo, N.Y.
Sterling Gas Co., Limited	66	Humberstone, Wainfleet, Moulton and Sherbrooke	Port Colborne.
Stevensville Gas & Fuel Co.	3	Bertie	Stevensville.
Sundy Gas Well Co.	3	Canboro	Dunnville.
Telephone City Oil & Gas Co., Ltd.	3	Onondaga	Brantford.
Union Natural Gas Co., of Ontario, Limited	124	Dover, Raleigh and Tilbury	Niagara Falls.
*United Gas Companies, Limited	53	Wainfleet, Moulton and Gainsboro	Buffalo, N.Y.
Vacuum Gas & Oil Co., Limited	2	Middleton	608 Lumsden Building, Toronto.
Vansickle, A. W.	2	Onondaga	Onondaga.
Wainfleet & Moulton Gas Co.	3	Middleton	Lowbanks, R.R. No. 1.
Welland County Lime Works Co., Limited	29	Wainfleet	Port Colborne.
Wedrick, M.	3	Walpole	Nanticoke.
Weylie & Benjamin	4	Glanford	Glanford Station, R.R. No. 2.

*Subsidiary company controlled by the Dominion Natural Gas Company, Limited, 842 Marine Bank Building, Buffalo, N.Y.

Following is a list of non-producing companies which pipe natural gas from the wells to points of consumption or who distribute it there:—

PIPE LINE COMPANIES OR DISTRIBUTORS ONLY OF NATURAL GAS.

Name of Company.	Miles of Pipe Line, Dec. 31, 1917.	Head Office.
Brantford Gas Co., Limited	58.9	Buffalo, N.Y.
Central Pipe Line Co., Limited	60.0	Chatham.
Chatham Gas Co., Limited	30.0	Chatham.
Independent Natural Gas Co.	....	Dunnville.
Ingersoll Gas Light Co., Limited	24.4	Buffalo, N.Y.
Lake Shore Natural Gas Co., Limited	7.1	294 Baynes St., Buffalo, N.Y.
Manufacturers Natural Gas Co., Limited	5.6	Buffalo, N.Y.
Nelles Corners Gas Co.	....	Nelles Corners.
Northern Pipe Line Co., Limited	35.8	P.O. Box 66, Niagara Falls.
Petrolia Utilities Co., Ltd.	12.0	Petrolia.
Rosehill Natural Gas Co., Limited	2.5	15 City Hall, Buffalo, N.Y.
Sarnia Gas Co., Limited	29.0	Sarnia.
Southern Ontario Gas Co., Limited	210.6	Buffalo, N.Y.
Tilbury Town Gas Co., Limited	12.5	P.O. Box 66, Niagara Falls.
United Gas & Fuel Co. of Hamilton, Limited*	325.0	72 James St. N., Hamilton.
Wallaceburg Gas Company	....	Wallaceburg.
Wellandport Natural Gas Company	....	Wellandport.
Windsor Gas Co., Limited	71.5	33 Chatham St. W., Windsor.
Woodstock Gas Light Co., Limited	44.1	Buffalo, N.Y.
Total	929.0	

* Company controlled by the Dominion Natural Gas Company, 842 Marine Bank Building, Buffalo, N.Y.

Gas and Oil Well Inspection

There are three oil and gas well inspectors appointed by the Provincial government to see that the regulations provided by the Legislature are observed in preventing the waste of natural gas and the proper plugging of abandoned wells. John Scott, of Petrolia, is inspector for the Lambton oil field; A. E. Near, Gas Line, for the Welland-Haldimand field, and J. W. Beno, Chatham, for Tilbury and surrounding territory. The effect of this inspection, and especially the operation of the tax on natural tax which is levied in full at two cents per thousand cubic feet when wasted, and only at one-tenth of this rate when consumed, has been to almost entirely eliminate the waste of this valuable fuel which was previously so common.

Extracts from the reports of the Inspectors follow.

A. E. Near states:—

Considerable drilling has been done during the year, especially by the two largest companies operating in this district, the Dominion Natural Gas Company, Limited, of Hamilton, and the Provincial Natural Gas and Fuel Company of Niagara Falls, Ont.

The Dominion Natural Gas Company drilled 67 wells, of which 47 were producing and 20 non-producing. They also purchased 7 wells and abandoned 44 exhausted ones, leaving them at the end of the year with 742 producing wells, from which they supplied gas to 38,812 customers.

The Provincial Natural Gas and Fuel Company drilled 13 wells in the Welland County field, of which only 4 were producing. They abandoned 13 exhausted wells, leaving them at the close of the year a total of 213 producing wells, from which they supplied their many customers in Niagara Falls, Welland, Bridgeburg, Fort Erie, Stevensville and Crystal Beach. On account of a general decline of gas this company on November 1 last ordered their customers to discontinue using gas for all furnaces and large heaters, in order to ensure an adequate supply for cooking purposes and light heating only.

In the Onondaga gas field, the Dominion Gas Company are operating 15 wells which produce oil as well as gas, and during the past year 450 barrels of oil were secured from these wells by means of pumps.

The Provincial Natural Gas and Fuel Company recently completed a gas well on the farm of A. E. O. Page in the township of Bertie at Point Albino, and secured an open flow of 500,000 cubic feet. This gas was obtained at a depth of about 3,300 feet, in the Trenton limestone.

The Sterling Gas Company of Port Colborne in November last completed two gas wells with an open flow of one million cubic feet. These wells are located in the township of Sherbrooke, in the county of Haldimand, at Lapp's Point on the Lake Erie shore a short distance east of Gull Island. This additional supply of gas is greatly appreciated by the citizens of Port Colborne and Humberstone, where the shortage of gas was experienced in the winter of 1916.

From information secured I can readily say there is without doubt a general decline of gas in pressure as well as in volume throughout this whole district.

Mr. Beno reports the following developments in the gas fields in the counties of Essex and Kent:—

In the Tilbury East, Romney and Raleigh area, the Glenwood Natural Gas Company, Limited, St. Thomas, drilled in 9 wells and 5 dry holes; the Union Natural Gas Company, Chatham, drilled 7 wells and 2 dry holes; the Canadian Natural Gas Company, Limited, Detroit, drilled 5 wells and laid 7 miles of 3-inch gas mains; the Beaver Oil and Gas Company, Limited, St. Thomas, drilled 2 wells, and the Dunegan Gas Company, Chatham, drilled 1 gas well.

In Dover West, the Union Natural Gas Company, Limited, drilled in gas well No. 1 on lot 3 in the third concession to a depth of 3,183 feet. This well came in with a rock pressure of 1,235 lbs., and a flow of 3,000,000 cubic feet of gas per day. It has since developed into a gas and oil well combined. The same company drilled four dry holes in the neighbourhood on the following lots and to the depths given: Dover township, lot 1, concession three, 3,765 feet; lot 4, concession three, 3,304 feet; lot 4, concession five, 3,265 feet; and lot 5, concession one, Tilbury East, 3,735 feet.

The Central Development Company struck a light gas flow at 1,421 feet on lot 16, concession fifteen, Raleigh township, and dry holes on lot 136 T.R.W., Raleigh, and lot 6, concession two Tilbury East, at a depth of 2,100 and 3,504 feet respectively. The Beaver Oil and Gas Company put down a dry hole 2,975 feet deep on lot 36 in the front concession of Gosfield South.

Altogether, in this field the following changes from the position in 1916 are reported: 2 oil wells, 24 gas wells and 13 dry holes drilled, also 15 miles of gas line laid down. The dry holes, in addition to 7 sunk in the Dover area, were on the following lots: Raleigh township, lot 1, concession thirteen; lot 19, M.R.N.; lot 5, concession thirteen; Tilbury East, lot 185, concession two, R.W.; Raleigh, lot 186, concession two, R.W.; lot 136, concession two, R.W.; Mersea, lot 2, concession six. Eight oil wells, 8 gas wells and 14 dry holes were abandoned, all of which were properly plugged according to the law.

The total number of gas wells being operated in this field is 280; oil wells, 34. The united length of all the gas mains, of size varying from 3 to 12 inches in diameter, is estimated at 517 miles.

Mr. Beno states that the gas supply has diminished from 50 to 60 per cent. during the last two years, by reason of the heavy draught on the wells, and opines that if this draught continues the field will soon be exhausted.

In the Lambton oil field there is a little gas, mainly at Oil Springs. There is also one well in the township of Euphemia. These have been in operation for some three years. There are no wells producing both oil and gas commercially, though a few oil wells yield gas enough to pump them.

Petroleum

Crude petroleum in 1917 exceeded the 1916 output by 214,019 Imperial gallons, the production being 7,104,700 gallons, as against 6,890,681 gallons. In price there was a series of advances which brought the value per barrel from $1.98 on January 1 to $2.48 on December 31, the average for the year being $2.34 per barrel. A small decline in the older fields was more than offset by the output of the new field in the Township of Mosa, Middlesex county, which produced 20,998 barrels during the year. This new pool is the most promising one located in recent years, and in the month of October yielded 6,889 barrels, or nearly as much as the best month's output from the Petrolea and Enniskillen field, at present the largest source of oil in Ontario. The oil in Mosa is found at a depth of 390 to 450 feet in the Corniferous limestone, which is also the oil-bearing formation of the older fields. The first strike was made by F. J. Carman on or about February 1, 1917. Up to the end of February, 1918, about 40 producing wells had been drilled, and 13 dry holes. A number of other wells were in process of being drilled. The pool as then located was on lots 5 to 8 in the fifth, sixth, and seventh concessions of the township. In quality the oil is good, the gravity being 33°. Facilities for handling and marketing the oil are satisfactory, tank cars conveying it from the field to the pipe line at Glencoe.

Drilling operations at Rockwood, in the county of Wellington, were not successful in obtaining oil. At Flesherton, Grey county, shows of oil have been found, but no reservoir has been located.

Oil was reported to have been found on the west bank of the Wanapitei river on lots 9 and 10, in the sixth concession of the township of Street, near the crossing of the Canadian Northern railway, and considerable local interest was aroused in the spring and early summer of 1918. An examination was made on behalf of the Bureau by E. S. Estlin, who found the presence of oil to be shown by a fine brilliant film which floated on the water when a shovelful of gravel taken from the bank was thrown into the river. Nearby were the remains of an old lumbering camp abandoned about 20 years ago, and upon clearing away the growth immediately above the gravel bank on the river side traces of a small building were found, the floor area being covered with chips and shavings saturated with what appeared to be ordinary coal oil. This was no doubt the site of the oil-house once connected with the lumber camp and also the source of the oil which showed in the gravel below. A little of the oil was with some pains procured from the floating films, and proved on examination to be coal oil or kerosene.

A comparison of the deliveries of oil from the several producing areas, for the years 1916 and 1917 is as follows, the figures being given in barrels of 35 Imp. gals.:—

PETROLEUM PRODUCTION BY FIELDS.

Field.	1916	1917	Gain	Loss
Lambton	142,208	132,524	.....	9,684
Bothwell	33,856	29,682	.....	4,174
Dutton	2,851	2,941	90	.....
Tilbury	16,296	10,041	.....	6 255
Onondaga	1,617	383	.....	1,234
Belle River	46	.....	.....	46
Mosa	.....	20,998	20,998	.....
Thamesville	.....	6,420	6,420	.....
Total	196,874	202,989	27,508	21,393

Inspector Scott furnishes the following list showing particulars of the oil wells of Lambton county and vicinity.

OIL WELLS, 1917

Municipality.	Pumped.	Baled.	Not operated.	Abandoned.	Total.
Sarnia township	174	.....	42	60	276
Plympton "	30	.....	42	21	93
Moore "	155	.....	61	55	271
Enniskillen "	2,477	437	896	121	3,931
Oil Springs	1,012	.....	63	27	1,002
Bothwell	278	.....	.....	7	285
Thamesville	15	.....	29	6	50
Dawn township	.....	.....	63	28	91
Euphemia township	56	.....	.....	22	78
Brooke township	10	.....	.....	2	12
Dutton	192	.....	15	.....	207
Mosa township	35	.....	.....	12	47
Indian Reservation	.....	.....	11	.....	11
Total	4,434	437	1,222	361	6,454

In Essex and Kent counties Inspector Beno reports that two new oil wells were sunk and eight wells abandoned during the year, the total number in operation being 34. This is a reduction of 17 from 1916, when 51 were being worked. The finding of oil in considerable quantity in the well bored for gas on lot 3, in the third concession of Dover West, is significant because of the fact that the oil was obtained in the Trenton limestone and at the great depth of 3,183 feet. The Corniferous formation has heretofore been the source of all Ontario petroleum, but the well in Dover West, notwithstanding the failure of other holes in the vicinity to reproduce its record, affords ground for the hope that deep exploitation of the Trenton, in the southwestern part of the Province, may prove that formation here to be an important reservoir of oil, such as it has proved to be in the northwestern part of the State of Ohio.

Salt

There was again an increase both in the quantity and value of the salt production, the output for 1917 being 138,909 tons, as compared with 128,935 tons in 1916, and the value $1,041,707 as compared with $700,515. The value of the packages is not included. The product was classified as follows:—Coarse, 46,537 tons; fine, 56,028 tons; table and dairy, 34,251 tons: land, 2,093 tons. Included in coarse salt is 14,301 tons, being the equivalent of the brine used by the Canadian Salt Company, Limited, in its chemical plant at Sandwich in the manufacture of caustic soda and bleaching powder. The number of workmen employed in the salt industry was 312, and the wages paid them were $234,925.

There is no salt mined in Ontario, the practice being to pump up the brine, which is then evaporated. Hence all the rock salt sold here for the use of cattle, etc., is imported.

Brunner, Mond Canada, Limited, are erecting a plant at Amherstburg for the manufacture of alkalies. The limestone required will be obtained from the company's quarries about three-quarters of a mile east of the plant, and the brine from its wells on lot 29, in the first concession of Anderdon township, three miles away. It is the company's intention to begin the production of soda ash at the rate of about 100 tons daily, and also at a later date to consider the manufacture of bicarbonates, caustics and chlorides. The works will not be turning out any product until the autumn of 1918.

The list of companies producing salt in 1917 is as follows:—

SALT COMPANIES, 1917.

Name of Owner, Firm or Company.	Location of Wells or Works.	P.O. Address of Manager, etc.
Canadian Salt Company, Limited	Windsor, Sandwich	Windsor.
Dominion Salt Company, Limited	Sarnia	Sarnia.
Elarton Salt Works Company, Limited	South of Egremont Road, Warwick tp.	Hyde Park.
Exeter Salt Works Company, Limited	Exeter	Exeter.
North American Chemical Co., Ltd.	Goderich, Clinton	Clinton.
Ontario People's Salt and Soda Co., Limited	Kincardine	Kincardine.
Western Canada Flour Mills Company, Limited	Goderich	Goderich.
Western Salt Company, Limited	Mooretown and Courtright	Courtright,
Wingham Salt Works (Alex. Young Estate)	Wingham	Wingham.

Talc

The production of talc continues to increase. In 1915 the shipments were 1,720 tons of crude and 9,285 tons of ground talc: in 1916, 3,665 tons crude and 8,145 tons ground; in 1917, 2,398 tons crude and 13,678 tons ground. The valuation of shipments, including both kinds, in 1915 was $85,325, in 1916 $111,489, and in 1917 $179,554. The talc deposits are situated near Madoc, in the county of Hastings, and the two mills for the grinding and preparation of the mineral are in that town. The latter are operated by Geo. H. Gillespie and Company,

Limited, and Anglo-American Talc Corporation respectively. Both the crude and ground product are for the greater part exported to the United States.

There were 56 employees engaged in the mining and milling of talc, who received in wages $19,734.

The uses of talc are numerous and important. The properties which are availed of in manufacturing processes are its foliated or fibrous structure, its softness, light colour, lustre, flexibility, unctuous feel, low conductivity and high absorption of heat and electricity. The most important employment of talc is in the manufacture of paper, especially in those varieties used for book and writing purposes. As a filler it not only adds to the weight of the paper, but it imparts whiteness to the colour and renders it opaque, absorptive and capable of taking on a high polish, thus fitting it for lithographing and illustrations. For paper-making, talc is to some extent displacing china clay. It is also used in the manufacture of rubber goods, in sizing and bleaching cotton cloth, in insulator coverings, in soap-making, as a dusting lubricant for shoes and gloves, in cosmetics and toilet preparations, paints, foundry facings, for dressing skins and leather, as a binder in gypsum wall plasters, and in the compact varieties for pencils, "tailors' chalk," and gas tips.

The firms engaged in the talc business were as follows:—

TALC OPERATORS, 1917.

Firm or Company.	Location of Mine or Works.	Address of Manager, etc.
Anglo-American Talc Corporation, Ltd..	Madoc	Madoc.
Cross and Wellington	Huntingdon tp.	Madoc.
*Eldorite, Limited	Eldorado	Eldorado.
Geo. H. Gillespie and Company, Ltd. .	Madoc (grinding mill)	Madoc.

* Idle in 1917.

Mining Divisions

The administration of the mining lands of the Province is primarily in the hands of the Recorders for the Mining Divisions in which are comprised the various mineral areas. When a prospector stakes out a claim, he must file his application with the Recorder for the Mining Division in which the land is situated. The Recorder is clothed by the Mining Act with power to settle disputes between the holders of mining claims, and there is a right of appeal from his decision to the Mining Commissioner, and in cases of importance from the latter to the courts of law. There are fifteen mining divisions in the Province, three of which, namely, Timagami Forest Reserve (part), Fort Frances and Eastern Ontario are administered by the Deputy Minister of Mines at the Department in Toronto. Of the others, Coleman Special Mining Division is in charge of the Mining Recorder for the Timiskaming Division at Haileybury, Gowganda under that of the Recorder for Montreal River Division at Elk Lake, and Kowkash under that of the Recorder for Port Arthur Division at Port Arthur.

Following is a statement which shows the collections on account of mining revenue by the several Mining Recorders during the fiscal year ending October 31, 1917:—

RECEIPTS OF MINING DIVISIONS, 1917.

Mining Division.	Name and Address of Recorder	Receipts, 1916–17.				
		Purchase Price.	Permits.	Miner's Licenses.	Recording Fees.	Total.
		$ c.	$ c.	$ c.	$ c.	$ c.
Kenora	W. L. Spry, Kenora	606 40	.....	456 00	539 75	1,602 15
Port Arthur	J. W. Morgan, Port Arthur	3,899 07	.....	2,464 00	2,899 60	9,262 67
Sault Ste. Marie	W. N. Miller, S.S. Marie	8,306 10	.....	837 00	1,194 50	10,337 60
Sudbury	C. A. Campbell, Sudbury	8,937 71	130 00	2,132 00	4,670 45	15,870 16
Timiskaming Coleman Special	N. J McAulay, Haileybury " "	4,137 84	50 00	5,314 00	3,651 75	13,153 59
Larder Lake	J. A. Hough, Matheson	23,664 90	.....	2,120 00	8,420 75	34,205 65
Gowganda Montreal River	A. J. Browning, Elk Lake " "	4,967 80	410 00	922 00	4,554 00	10,853 80
Porcupine	G. H. Gauthier, S. Porcupine	5,205 12	60 00	2,040 15	4,137 10	11,442 37
Parry Sound	H. F. McQuire, Parry Sound	.....	.....	225 00	303 00	528 00
Kowkash	M. R. Morgan, Tashota	.....	120 00	842 00	2,322 50	3,284 50
	Total	59,724 94	770 00	17,352 15	32,693 40	110,540 49

Mr. A. J. Browning died of pneumonia after a week's illness, April 30, 1918, and was succeeded by Mr. H. E. Sheppard, formerly Mining Recorder for Gowganda and Montreal River Divisions, who had returned from overseas service in France and received his discharge. The head office of the Kowkash Division was removed to Port Arthur by Order-in-Council, dated January 28, 1918, and was placed under the charge of Mr. J. W. Morgan, the Recorder for Port Arthur Division. The almost entire cessation of business in Kowkash Division made this step expedient.

Reports from Mining Recorders

In reporting to the Bureau upon the business of the year, the Mining Recorders occasionally remark upon matters of current interest in their several Divisions. Extracts from these reports are appended herewith:—

Kenora.—Claims recorded, 32; cancelled, 16. Mining activity has been less than usual. At the Rognon mines new camps have been built to accommodate more men, and it is the intention to move 600 tons of ore to the mill at the Redeemer mine in Van Horne township for treatment. Southwest of English and near Keewatin lake, the Nicuso syndicate of Ottawa have spent a large amount of money in development work, a diamond drill being in use most of the summer on a deposit of iron pyrites. Just east of Quibell, on the National Transcontinental railway, in the unsurveyed township of Buller, another large deposit of pyrite has been found and several claims recorded. At Northpines the Nichols Chemical Company are doing a big business and employ a large number of men.

Port Arthur.—Claims recorded, 180; cancelled, 59. No new discoveries of much importance have been made in this Division during the year 1917. So many prospectors have joined the army for service in France that little prospecting can be expected until the end of the war.

Sault Ste. Marie.—Claims recorded, 135; cancelled 9. The whole mining division from Michipicoten to Bruce Mines, and as far north as the township of Hayward, has been unusually active. The gold claims near Wawa lake, Michipicoten, which have been lying dormant for many years, are likely to be re-opened and worked by a strong Pittsburg company. In township 49, on the Algoma Central railway, Dan McCarthy, while prospecting for iron pyrites in October, 1917, found a vein of quartz with a spectacular showing of free gold. He and his party staked eight claims, having found free gold on five of them. Other discoveries of free gold have since been made, and claims staked. J. P. Cline, of South Porcupine, made a good discovery of free gold at Pine lake, on the eastern boundary of township 49. The gold occurs in schist between large bodies of pyrite, claims for which have also been staked on the boundary line between townships 49 and 27. Mr. Harry Dreany has had a diamond drill operating on his iron claims, and has located a large body of ore. Gold was discovered in the township of Hayward.

Sudbury.—Claims recorded, 262; cancelled 62.

Timiskaming: Coleman Special.—Claims recorded, 269; cancelled, 75. There was little prospecting in these divisions, except in Rickard township, where a discovery of gold was made by one John Raty, and three claims taken up which were optioned to the Mining Corporation of Canada and are now being developed. Several discoveries were reported from the township of Eby and a number of claims recorded. Very little development work was done, except where necessary to hold new claims, largely because of the general extension of time given on old claims by the Order-in-Council of May 26, 1917. This extension, however, was of material benefit to a number of prospectors. Fewer miner's licenses were issued owing to the number of prospectors who have enlisted and are serving their country overseas.

Larder Lake.—Claims recorded 160. Receipts show an increase over 1916 of nearly $3,000. This division is steadily growing in importance, and during the year 1918 should add to the list several new producing gold mines. Much development work was done, principally at Kirkland Lake, Boston Creek, Skead, Larder Lake and Munro. Several discoveries were made; one of which, near Bourke's, in the township of Benoit, appears to be of exceptional merit. Another, assaying well in gold content, was made in August in the unsurveyed territory south of Lake Abitibi, on the Lightning river. Many of the best prospectors of this division lie buried in France and Flanders.

Gowganda.—Claims recorded, 113; cancelled, 80. The chief staking was around the O'Brien mine, in Nicol and Haultain, and around Reeve-Dobie, in Milner. The following properties have been worked: O'Brien mine, Castle, Welsh claims, T.C. 177, Collins on Leroy lake, Mining Corporation of Canada on Hylands claims, all in Nicol Township; Crews-McFarlan, Reeve-Dobie, Silverado, in Milner.

Montreal River.—Claims recorded, 294; cancelled, 147. A considerable amount of prospecting was done, and the receipts were two and a half times as much as in 1916. This was due chiefly to the staking in Powell, Cairo, and Yarrow townships, owing to the discovery of gold on the McKay-Davidson and

Otisse claims. A road has been cut from a point on the Montreal river above Indian Chutes so as to enable machinery to be placed on the properties. Mining was done in Auld township on Kenabeek mines, in Cane on Quesnell claims, in Mickle at the Brant mines (old Mapes-Johnston), and at White Reserve in Maple Mountain area, also some work at McKenzie lake in Speight. Lieut. Skill, long Recorder of this division, was killed in action somewhere in France in 1917.

Porcupine.—Claims recorded, 236; cancelled, 160. There was a considerable falling off in receipts, directly attributable to the extensions granted for assessment work to men serving overseas, and to other claim-holders on account of war conditions. There have been no new finds afield. Prospecting and staking were confined to claims as they became open in the older portions of the camp. The numerous extensions of time have kept most of the claims in good standing and put an end to activity for the time being. The showing maintained by the producing mines in 1917, in spite of the shortage of labour and largely increased cost of production due to war conditions, was most gratifying.

Parry Sound.—Claims recorded, 25. Some mica claims in McConkey township were sold to Detroit parties who are preparing to work them during the summer of 1918. Some feldspar claims have changed hands, also the Parry Sound Copper Mining Company's holdings near Parry Sound, where the new owner did some diamond drilling.

Kowkash.—Claims recorded, 135; cancelled, 69. During the first nine months business was good, but winter set in about October 1 and all mining and prospecting came to an end, the Wells property having been closed down.

Mining Companies

Mining companies incorporated under the laws of Ontario numbered 100 in 1917, with an authorized capitalization of $117,183,000, as against 83, with a nominal capital of $109,075,500, in 1916. There were seven companies of foreign incorporation licensed to do business in the Province, and to employ capital amounting in the aggregate to $7,202,000.

The lists follow:—

MINING COMPANIES INCORPORATED IN 1917.

Name of Company.	Head Office.	Date of Incorporation.	Capital.
Algoma Exploration & Development Co., Ltd...	Sault Ste. Marie	Aug. 29.....	$40,000
Alloy Steel Works, Limited	Toronto	Oct. 15.....	2,000,000
Anglo-Kirkland Gold Mines, Limited	Haileybury	Mar. 17.....	500,000
Asquith Gold Mining Company, Limited	Toronto	Oct. 9.....	2,000,000
Atlas Gas & Oil Company, Limited	Toronto	April 3.....	300,000
Baldwin Gold Mining Company, Limited	Toronto	Feb. 13.....	2,500,000
Bellinger-Porcupine Mines, Limited	Toronto	Mar. 2.....	2,000,000
Big Duck Lake Mining Company, Limited	Ottawa	July 14.....	30,000
Bolton Mining Company, Limited	Windsor	Jan. 4.....	500,000
Bourkes Mines, Limited	Toronto	July 21.....	2,500,000
Brant Mines, Limited	Brantford	Sept. 1.....	1,500,000
Buffalo Kirkland Mines, Limited	Toronto	Mar. 21.....	1,500,000

MINING COMPANIES INCORPORATED IN 1917.—*Continued.*

Name of Company.	Head Office.	Date of Incorporation	Capital.
Bungalow Brick Company, Limited	Toronto	April 3	40,000
Canadian Oil Fields, Limited	Brantford	Jan. 9	500,000
Cane Silver Mines, Limited	Toronto	Oct. 12	1,500,000
Castle Mining Company, Limited	Toronto	Sept. 7	1,500,000
Chaput-Hughes Gold Mines, Limited	Toronto	April 11	2,000,000
Colossus Gold Mines, Limited	Toronto	Jan. 19	2,000,000
Continental Development Company, Limited	Toronto	Feb. 12	250,000
Consolidated Metals Corporation, Limited	Toronto	Oct. 17	3,000,000
Crœsus Lake Gold Mines, Limited	Toronto	Aug. 1	1,000,000
Crystal Products, Limited	Toronto	Sept. 26	300,000
Delta Chemical Company, Limited	Toronto	Aug. 15	40,000
Dominion Kirkland Gold Mines, Limited	Toronto	Oct. 6	2,000,000
Dominion Mica Mining Company, Limited	Toronto	April 2	50,000
Dominion Molybdenites, Limited	Toronto	May 2	1,000,000
Eastern Mining and Milling Company, Limited	Toronto	Sept. 1	500,000
East Kirk Mining Company, Limited	Toronto	Jan. 20	2,500,000
Feldspar Milling Company, Limited	Toronto	May 3	50,000
Feldspar Quarries, Limited	Toronto	Feb. 15	40,000
Fidelity Mining & Development Co., Limited	Haileybury	May 14	2,000,000
Fisher Gold Mining and Milling Co., Limited	Toronto	June 5	2,500,000
Flesherton Oil Fields, Limited	Windsor	Aug. 27	500,000
Galt Building Products, Limited	Galt	May 7	40,000
Gold Banner Mines, Limited	Toronto	Sept. 21	2,000,000
Graham Development & Contracting Co., Ltd.	Fort William	July 23	100,000
Howrey Creek Mining Corporation, Limited	Toronto	Dec. 7	1,000,000
Kent County Oil, Gas and Coal Co., Limited	Windsor	Dec. 19	40,000
Kerr Lake Mines, Limited	Cobalt	Oct. 13	3,000,000
Kirkland Combined Mines, Limited	Toronto	May 28	2,000,000
Kirkland-Porphyry Gold Mines, Limited	Haileybury	Aug. 3	3,000,000
Kirkland-Townsite Gold Mines, Limited	Haileybury	Mar. 15	2,000,000
Lucky Cross Bondholders, Limited	Toronto	Sept. 14	100,000
McConnell Consolidated Mines, Limited	Toronto	April 16	1,000,000
McEnaney Gold Mines, Limited	Toronto	June 30	3,000,000
McGinley-Teck Gold Mines, Limited	Haileybury	April 27	2,000,000
Macassa Gold Mines, Limited	Toronto	Feb. 10	2,000,000
Mineral Products, Limited	Madoc	Feb. 2	100,000
Nickel Lake Mining Company, Limited	Fort Frances	Dec. 10	1,000,000
Nipissing Mines Company, Limited	Toronto	June 28	6,000,000
North Davidson Mines, Limited	Toronto	Mar. 30	2,000,000
Ontario-Kirkland Gold Mines, Limited	Haileybury	Sept. 18	1,500,000
Ontario Molybdenum Company, Limited	Toronto	April 17	40,000
Oxford Lime Products, Limited	Woodstock	April 18	40,000
Paragon-Hitchcock Mines, Limited	Collingwood	May 22	2,000,000
Paudash Lake Molybdenite Mines, Limited	Wilberforce	Nov. 13	150,000
Penn Porcupine Mining Co., Limited	Toronto	Feb. 2	3,000,000
Pontiac Molybdenite Company, Limited	Toronto	May 12	500,000
Porcupine Whelpdale Mines, Limited	Toronto	Sept. 13	2,500,000
Rand Consolidated Mines, Limited	Toronto	July 12	5,000,000
R.A.P. Gold Mining Co., of Boston Creek, Ltd.	Toronto	Jan. 29	2,500,000
Reeve-Dobie Mines, Limited	Toronto	May 1	2,000,000
Rockwood Oil and Gas Company, Limited	Toronto	Oct. 9	1,000,000
Rominco Mines Company, Limited	Toronto	Mar. 12	10,000
Rypan Porcupine Mines, Limited	Toronto	Jan. 23	2,000,000
St. Luke's Oil and Gas Company, Limited	Toronto	July 24	2,000,000
Sarvice, Limited	Chatham	July 9	48,000
Sesekinika Lake Gold Mines, Limited	Toronto	Jan. 18	2,000,000
Standard Gravel Company, Limited	Niagara Falls	Feb. 24	40,000
T.C. 177 Mining Company, Limited	Gowganda	Mar. 10	40,000
Thackeray Mines, Limited	Toronto	April 19	2,000,000
The Battle Natural Gas Company, Limited	Hamilton	Oct. 11	100,000
The Cascade Lead-Silver Mines, Limited	Toronto	May 9	1,000,000
The Duck Lake Mining Company, Limited	Fort William	Dec. 26	250,000

MINING COMPANIES INCORPORATED IN 1917.—*Continued.*

Name of Company.	Head Office.	Date of Incorporation	Capital.
The Glenn-Clayton Mining Company, Limited..	Toronto	Mar. 2.....	1,000,000
The Goldore Mining Corporation Limited	Toronto	Feb. 17.....	40,000
The Great West Chemical Corporation, Limited	Port Arthur	Oct. 31.....	1,500,000
The Hennepin Mining Company, Limited	Port Arthur	Feb. 20.....	40,000
The Hope Exploration Co. of Canada, Limited	Niagara Falls ..	Feb. 6.....	100,000
The Indian Trail Mines, Limited	Toronto	Nov. 15.....	1,000,000
The London Smelting and Refining Co., Ltd...	London	Mar. 14.....	45,000
The Maple Leaf Exploration Company, Limited	Toronto	Sept. 22.....	40,000
The Merlin Oil and Gas Company, Limited	Merlin	April 26.....	40,000
The Mining Investors' Corporation, Limited ..	Toronto	Sept. 19.....	40,000
The National Potash Corporation, Limited	Toronto	April 30.....	1,500,000
The Progressive Gas and Oil Co., Limited	Hamilton	Aug. 18.....	1,000,000
The St. Clair Oil and Gas Corporation, Limited	Toronto	Jan. 30.....	3,000,000
The Shining Tree Mining and Milling Co., Ltd.	Sudbury	April 13.....	500,000
The Tilbury Brick and Tile Company, Limited	Tilbury	Feb. 15.....	40,000
The Tory Hill Marble and Mica Co., Limited..	Toronto	Mar. 21.....	100,000
The Velvet Mining Company, Limited	Windsor	Mar. 12.....	40,000
The Walkerville Brick and Tile Co., Ltd.	Walkerville	Oct. 31.....	40,000
Trenton Gas & Oil Company, Limited	Toronto	Aug. 9.....	40,000
Union Cement, Limited	Owen Sound ...	May 4.....	1,000,000
United Kirkland Gold Mines, Limited	Haileybury	May 10.....	2,000,000
Vandorf Brick Works, Limited	Toronto	Oct. 5.....	40,000
Warco Oil and Gas Company, Limited	Brantford	Sept. 6.....	300,000
Wasapika Gold Mines, Limited	Toronto	June 7.....	1,000,000
Wisconsin-Skead Mines, Limited	Haileybury	Aug. 27.....	2,000,000
Wright-Porcupine Mines, Limited	Haileybury	Jan. 30.....	2,000,000
		Total.....	$117,183,000

MINING COMPANIES LICENSED IN 1917.

Name of Company.	Head Office for Ontario.	Date of License.	Capital for use in Ontario.
Electric Steel & Engineering, Limited	Welland	July 18.....	$2,000,000
McLaurin Mining Company	Port Arthur	Feb. 8.....	50,000
National Abrasive Company	Toronto	May 18.....	60,000
Ontario Petroleum Co.	Bothwell	Nov. 20.....	40,000
Ontario Western Mining Company, Limited ...	Cobalt	June 7.....	12,000
The International Nickel Co. of Canada, Ltd..	Toronto	Jan. 6.....	5,000,000
The Solvay Process Company	Toronto	Mar. 31.....	40,000
		Total	$7,202,000

Mining Revenue

Sources of Government revenue are the following: Sales and leases of mining lands, miners' licenses, recording and other fees under the Mining Act, royalties on sand and gravel, and taxes levied under the Mining Tax Act, namely, on mining profits, mining lands, and natural gas. Of these the tax on profits is the most considerable. The Act puts a tax of 3 per cent. on the net profits of mining companies up to $1,000,000, and a graded rate beginning at 5 per cent. on profits in excess of this amount, the first $10,000 of profits being exempt. An exception is made of nickel-copper mining concerns, whose rate is graded from 5 per cent. upward, and is computed on the selling price of the refined products less the cost of production.

The revenue for the fiscal year ending October 31, 1917, was as follows:—

Sales of mining land	$57,054 50
Mining leases	16,845 01
Miner's licenses, recording fees, etc.	62 256 41
Sand and gravel royalties	28,372 93
Mining Tax Act	1,557,543 37
Provincial Assay Office	726 52
Miscellaneous	31 50
Total	$1,722,830 24

Sales and Rentals.—Mining lands are sold at $2.50 per acre in the unsurveyed territory, where the purchaser is obliged to procure a survey at his own expense, or $3.00 per acre in the surveyed lands which have been laid out by the Government. In Forest Reserves, mining lands are disposed of only by lease for a period of ten years, renewable at option of the lessee. The following table of mining lands sold and leased gives the particulars for the fiscal year. The receipts do not quite agree with those given in the above summary, since the latter comprises all sums received, while in the table is included only sales and leases actually completed within the year.

MINING LANDS SOLD AND LEASED, 1917.

District.	Sales.			Leases.			Total.		
	No.	Acres.	Amount.	No.	Acres.	Amount.	No.	Acres.	Amount.
			$ c.			$ c.			$ c.
Timiskaming	359	12,496.52	33,382 39	93	3,292.75	3,052 90	452	15,789.27	36,435 29
Thunder Bay	37	1,398.97	3,258 69	3	120.00	120 00	40	1,518.97	3,378 69
Algoma	47	2,796.44	7,031 16	....	.....	.....	47	2,796.44	7,031 16
Sudbury	57	2,251.62	6,732 28	43	1,549.54	1,549 54	100	3,801.16	8,281 82
Nipissing	5	263.42	602 75	....	.....	.....	5	263.42	602 75
Kenora	7	260.30	590 75	....	.....	.....	7	260.30	590 75
Elsewhere	14	687.04	1,387 62	....	.....	.....	14	687.04	1,387 62
Total	526	20,154.31	52,985 64	139	4,962.29	4,722 44	665	25,116.60	57,708 08

Miner's Licenses, Recording Fees, etc.—For a miner's license entitling the holder to stake out mining claims on Crown lands a fee of $5 is fixed by the Mining Act. A license is good until March 31 next after the date of issue, and may be renewed on or before April 1 at a like cost. A license issued after October 1 costs $3 only. A permit to prospect for minerals in a Forest Reserve costs $10, and is good for twelve months. The fee for recording a mining claim is $10.

Sand and Gravel Royalties.—As already stated, licenses may be issued for the removal of sand and gravel from Crown lands on payment of a royalty charge varying from three to twelve cents per cubic yard. These lands are for the most part those covered by the waters of the great lakes or boundary rivers.

Mining Tax Act.—Revenue is derived from three sources, the receipts for the fiscal year being as follows:—

Acreage tax	$14,347 99
Profit tax	1,503,967 62
Natural gas tax	39,227 76
Total	$1,557,543 37

In 1916 the receipts were $186,827.12.

By amendment to the Mining Tax Act passed at the session of 1917, the tax on mining lands was increased from two to five cents per acre, and it was made applicable to mining land wherever situated, instead of to areas only without county organization, as formerly. The higher rate may be expected to produce a somewhat larger revenue.

An explanation has already been given of the changes made in the Mining Tax Act, so far as the profit tax is concerned. Following is a statement, classified according to products, of the mining companies who paid the profit tax and the respective amounts paid during the last fiscal year:—

Gold:		
Porcupine Crown Mines, Limited	$3,771 50	
The Dome Mines Company, Limited	7,597 46	
McIntyre-Porcupine Mines, Limited	4,195 54	
		$15,564 50
Silver:		
The Mining Corporation of Canada, Limited	$10,494 55	
Seneca-Superior Silver Mines, Limited	6,640 20	
Nipissing Mining Company, Limited	40,358 44	
Cobalt Comet Mines, Limited	288 45	
Kerr Lake Mining Company, Limited	14,393 25	
Crown Reserve Mining Company, Limited	184 74	
McKinley-Darragh-Savage Mines of Cobalt, Limited	3,883 95	
Penn-Canadian Mines, Limited	207 50	
La Rose Mines, Limited	3,328 56	
Timiskaming Mining Company, Limited	2,766 46	
The Coniagas Mines, Limited	9,811 27	
M. J. O'Brien	5,682 09	
Casey Cobalt Silver Mining Company, Limited	1,134 28	
		99,173 74
Pyrite:		
Northern Pyrites Company	$715 60	
The Nichols Chemical Company, Limited	498 57	
		1,214 17
Nickel-Copper:		
Alexo Mining Company, Limited	$468 87	
The Mond Nickel Company, Limited	20,000 00	
The Canadian Copper Company, 1916	530,110 00	
The Canadian Copper Company, 1917	836,782 00	
		1,387,360 87
Miscellaneous:		
Algoma Steel Corporation (Iron)	$135 48	
Cross and Wellington (Talc)	5 72	
Black Donald Graphite Company, Limited (Graphite)	513 14	
		654 34
Total		$1,503,967 62

It should be added that the taxes under the Mining Tax Act are payable on or before October 1. Occasionally there is some delay in adjusting or remitting the amount, and payment may not be actually made until after the close of the financial year, which ends with October. This will account for the absence of one or two mining companies from the above list, which includes only those who paid within the fiscal year.

Operation of the Mining Tax Act in 1917

Mr. G. R. Mickle, Mine Assessor, makes the following comments:—

Under this Act three taxes are levied, viz.: (1) the Profit Tax, being on the profits made by the different mining companies computed as outlined in the Act with certain deductions for taxes paid municipalities; (2) the Natural Gas Tax, being a fixed amount of two-tenths of a cent per thousand cubic feet; and (3) the Acreage Tax of five cents per acre on all mining lands. The total amount paid in respect of these taxes for 1917 amounted to $1,643,847.39, and the distribution is as follows:—

Profit Tax	$1,583,864 07
Natural Gas Tax	36,057 90
Acreage Tax (15th April, 1917, to 15th April, 1918)	23,925 42
Total	$1,643,847 39

These amounts given above are the taxes belonging to 1917 which are not due till Oct. 1st, and consequently some of them are not paid before the end of the fiscal year for the Province, Oct. 31st. This statement, therefore, will not agree with the Public Accounts.

Of this amount $555,879.12 was tax for 1916 on nickel mines which was not collected or determined in 1916, as the Act was entirely altered with respect to nickel and nickel-copper mines. Any comparison with past years is of no value under these circumstances. Of the total amount collected as profit tax, nickel mines contributed $1,413,129.99; silver mines, $94,606.29; gold mines, $75,215.51; and miscellaneous mines, $902.28.

The natural gas tax was about 20 per cent. more than was collected last year. Unless important new fields are found there must be a decline of revenue from this source, since the output is being restricted as explained elsewhere in this Report.

The acreage tax is the largest collected in any year, due to the increase of the tax from two to five cents per acre. It is too soon to judge yet what the effect of this change will be. According to the average rate of collection per year of the two cent tax, about 15 per cent. of the lands are in arrears for the 1917 tax; whether this means that the owners of these lands intend to let the title lapse or are merely taking breath, will be known in a year or so.

Provincial Assay Office

W. K. McNeill, Provincial Assayer, reports as follows for the year 1917:—

To an increased demand for minerals occasioned by war conditions, probably, was due to a great extent the increase in the work of this Office for the year. The Assay Office was utilized more than ever by those interested in the mining industry, and apart from actual assaying of ores and mineral products, a great deal of general information and advice was given, for which no fee was charged.

During the year the equipment was augmented by a Brown crusher and pulverizer and a Case gas assay furnace.

The work, as in former years, may be classified as follows:

1. Examination and assaying of samples for prospectors, mining engineers, geologists, and the public generally. For this work the Department charges the regular fee.
2. Analyses of samples of rocks, etc., for the geologists of the Bureau of Mines.
3. The sampling of car lots of Cobalt silver ores shipped from the mines, upon which the government collects a royalty. This work is in charge of Mr. T. E. Rothwell, Assistant Assayer.
4. The assaying and valuation of these car lots.
5. Assaying of the products of the Cobalt silver ores, for which the government gives a bounty.
6. Special research work.

The work may be further classified as follows:

Gold and Silver Assays.—803 samples were submitted for gold and silver, including car lots, each car being represented by one sample.

Platinum minerals.—15 samples were submitted for platinum minerals. These were also tested for palladium, iridium and other allied metals.

Copper ore.—57 samples were analysed for copper. These were mostly from Ontario, although a few were sent from the province of Quebec.

Nickel and Cobalt ores.—51 samples were tested for nickel and cobalt.

Iron ores.—15 samples were analysed for iron, sulphur and phosphorus.

Molybdenum ores.—39 samples, mainly concentrates, were received and reported upon.

Zinc and Lead ores.—23 samples were analysed for the zinc and lead content.

Rock analyses.—14 rock samples were submitted by the Provincial Geologist for complete analysis.

Limestones.—79 samples were submitted; of these 14 were for complete analysis, the others for magnesia content.

Identification.—96 samples were submitted by mail and reports issued. In addition, some hundreds of samples were brought directly to the office and identified. No charge is made for this work.

Miscellaneous.—60 samples were submitted. Under this heading are included barite, fluorspar, manganese, chromium, etc.

The work of the Department is carried on with the assistance of T. E. Rothwell, Assistant Assayer, and A. T. Leat, who is employed as a sampler and general assistant.

Samples sent in by the public will be dealt with in the order of their arrival. In every instance specimens and samples should be accompanied by statement specifying the precise locality from which they were taken.

Crushed samples representing large quantities or samples less than five pounds weight may be sent by mail as third class matter. Write name and address plainly on each parcel. Send instructions, with money in payment of fees in a separate letter. Samples may be sent by express, charges prepaid.

Sample bags addressed to the Laboratory for sending ore pulp by mail may be obtained free on application; also canvas bags for shipping.

Money in payment of fees, sent in by registered letter, post-office order, postal note, or express order, and made payable to the Provincial Assayer, must invariably accompany sample to insure prompt return of certificate, as no examination is commenced until the regulation fee is paid.

Samples addressed as follows: "To Provincial Assay Office, 5 Queen's Park, Toronto, Ont."

The following schedule of fees is as revised, and took effect June 1st, 1918:

TARIFF OF FEES FOR ANALYSES AND ASSAYS

1. Assays:

Gold	$1 50
Silver	1 50
Gold and Silver in one sample	2 50
Platinum Minerals	5 00
Gold and Platinum Minerals in one sample	7 00
Separation of Platinum Minerals	Prices on application.

2. Iron Ores:

Iron (metallic)	$1 50
Silica	1 50
Iron and Insoluble residue	2 50
Ferrous Oxide	2 00
Phosphorus	3 00
Sulphur	2 50
Iron, Sulphur, Phosphorus and insoluble	8 00
Manganese	3 00
Titanium	4 00
Complete analysis	Price on application.

3. Limestones, Dolomites, Marls, Clays, Shales:

Determination of:

Insolubles	$1 50
Silica	1 50
Ferric Iron	3 00
Ferrous Iron	2 00
Alumina	3 00
Lime	2 00
Magnesia	2 50
Potash	5 00
Soda	5 00
Alkalies (on one sample)	6 00
Water (combined)	2 00
Moisture	1 00
Carbon Dioxide	2 00
Sulphur	2 50
Phosphorus Anhydride	3 00

4. Examination of Clay, Shale, or Cement Rock for Cement Manufacture:
Determination of:
Silica, Iron Oxide, Alumina, Lime, Magnesia, Sulphur, and Volatile matter. Prices on application.

5. Coal, Coke, Peat, Etc.:
Determination of:

Moisture	$1 00
Volatile Combustible	1 50
Fixed Carbon	1 50
Ash	1 50
Sulphur	2 50
Phosphorus	3 00
Calorific value (B.T.U.)	5 00
Ultimate analysis	Price on application.

6. Mineral Waters ..... Price on application.

7. Ores and Minerals:

Determination of:

Alumina	$3 00
Antimony	4 00
Arsenic	4 00
Bismuth	4 00
Cadmium	4 00
Chromium	5 00
Cobalt	5 00
Nickel	5 00
Cobalt and Nickel on same sample	6 00
Copper	2 00
Fluorite	4 00
Lead	3 00
Molybdenum	4 00
Manganese	3 00
Tin	4 00
Zinc	3 00

8. Rocks, Complete Analysis ..... Price on application.

9. Slags, Sand, Etc. ..... Price on application.

10. Identification of Minerals and Rocks not requiring Chemical Analysis... Free.

11. Test for Radio-Activity ..... Free.

Any analytical work not specified in this circular will be undertaken on application to the Provincial Assayer.

The pulp of each sample is retained for future reference.

MINING ACCIDENTS IN 1917

Chief Inspector of Mines, T. F. Sutherland, Toronto; Inspectors, E. A. Collins, Cobalt; J. H. Stovel, Sudbury

During the year 1917 at the mines, metallurgical works, quarries, clay and gravel pits regulated by the Mining Act of Ontario there were 34 fatal accidents causing the death of 36 men, as compared with 51 deaths in 1916. Of these, 18 accidents resulting in 19 deaths occurred underground. Seven men were killed above ground at the mines, six at the metallurgical works, and four at the quarries.

Seventeen companies had fatal accidents during the year.

Table of Fatalities

	1916	1917
Mines, underground	30	19
Mines, surface	7	7
Metallurgical works	8	6
Quarries	6	4
Total	51	36

The fatalities at the mines were divided amongst the several districts as follows:

	1916	1917
Gold mines of Porcupine and Kirkland Lake	14	8
Silver mines of Cobalt and adjacent districts	8	9
Nickel-copper mines of Sudbury	13	9
Iron mines of Michipicoten	2	0
Total	37	26

By months the fatalities occurred as follows:

	1916	1917
January	7	8
February	4	3
March	1	2
April	2	3
May	7	2
June	5	0
July	1	5
August	2	6
September	3	1
October	1	3
November	10	0
December	8	3
Total	51	36

Analysis of Fatalities at Mines

Cause:—	1916 Per cent.	1917 Per cent.
Falls of ground	24.3	15.4
Shaft accidents	27.0	15.4
Explosives	21.6	15.4
Miscellaneous underground	8.1	26.9
Surface	18.9	26.9

Table of Fatal Accidents in Mines, Metallurgical Works and Quarries, 1901 to 1917

—	Persons killed at metallurgical works and mines.	Persons employed at metallurgical works and producing mines.	Persons employed at non-producing mines (estimated).	Total persons employed.	Fatal accidents per 1,000 employed.
1901.....	13	4,135	550	4,685	2.77
1902.....	10	4,426	450	4,876	2.05
1903.....	7	3,499	400	3,899	1.79
1904.....	7	3,475	400	3,875	1.80
1905.....	9	4,415	500	4,915	1.83
1906.....	11	5,017	750	5,767	1.90
1907.....	22	6,305	1,140	7,445	2.93
1908.....	47	7,435	1,750	9,185	5.11
1909.....	49	8,505	2,000	10,505	4.66
1910.....	48	10,862	2,000	12,862	3.73
1911.....	49	12,543	2,000	14,543	3.37
1912.....	43	13,108	2,000	15,108	2.84
1913.....	64	14,293	2,000	16,293	3.93
1914.....	58	14,361	1,500	15,861	3.60
1915.....	22	13,114	1,500	14,614	1.51
1916.....	51	14,624	2,000	16,624	3.07
1917.....	36	16,791	1,000	17,791	2.02
Total.....	546	156,908	21,940	178,848	3.05

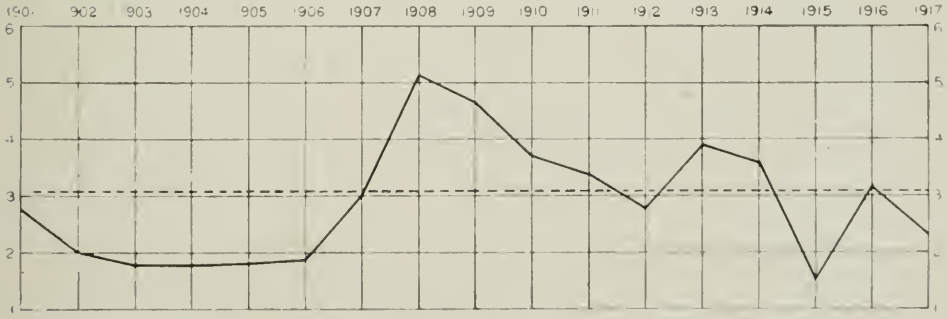


Diagram showing Mining Fatalities per thousand men employed between the years 1901-1917. The dotted line represents the average for the period.

The occupation and nationality of the men killed are set out in the following table:

Occupation.	English-speaking.	Austrian.	Finn.	Bulgarian.	Russian.	German.	Italian.	Total.
Machine runner	3	2	1		1			7
Trammer	1	3			1		1	6
Machine helper	3		2					5
Labourer	2	1						3
Foreman	2							2
Blockholer				1		1		2
Hoistman	2							2
Chute blaster				1				1
Timberman	1							1
Millman	1							1
Mechanic	1							1
Teamster	1							1
Engineer	1							1
Stovetender	1							1
Coal dryer	1							1
Ladleman		1						1
Total	20	7	3	2	2	1	1	36

The ages of the men killed were as follows:

17–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	Total.
2	7	10	4	5	4	1	1	2	36

Cause and Place of Fatalities in Mines

Below Ground:—
- Falls of ground 4

Shaft Accidents:—
- Falling from skip 1
- Struck by objects falling down shaft 1
- Falling down shaft 2

Explosive Accidents:—
- Walked into blast 2
- Premature explosion while lighting holes 1
- Remaining in vicinity of blast and struck by rock 1

Miscellaneous Accidents:—
- Falling down raise 1
- Falling down ore pass 1
- Rock rolling down stope 1
- Ore falling from chute 1
- Crushed between car and chute 1
- Timber falling down raise 1
- Stull breaking 1

Above Ground:—
- Struck by loaded skip (ore transportation) 1
- Slipped under moving locomotive (ore transportation) 1
- Slide of lumber from loaded car 1
- Caught by counterweight cable 1
- Wound around pulley in mill 1
- Kicked by horse 1
- Falling down rock dump 1

Metallurgical Plants:—
- Asphyxiation 1
- Burned by hot gases 1
- Ran over by railroad car in yard 1
- Struck by ladle 1
- Fall from oiling platform 1
- Crushed between passenger coach and platform 1

Quarries:—
- Explosion in magazine 2
- Caught in conveyor belt 1
- Fall of rock from face 1

Falls of Ground

This was formerly a prolific cause of fatal accidents, particularly in the larger mines of the Province. Due to more efficient scaling methods, fatalities from this cause have been greatly reduced. During the year 1917 four men were killed by falling ground, three in Cobalt and one in Sudbury. At the Trethewey mine, April 17th, two shovellers were warned away from dangerous ground by the shift boss. While attempting to leave the stope one man fell into the open top of the chute into which they were shovelling, and was struck by the rock rolling down the stope. He died from his injuries April 22nd.

At the Nipissing Fourth of July shaft on January 12th two men were struck by falling ground while scaling in a winze. The shift boss had ordered two machine crews to scale the walls of the winze carefully. The corner of the winze where the fall occurred had been scaled with picks, but a scaling bar or gad was not used. One of the helpers, David, was instantly killed and his partner, Lauzon, received serious injuries, and died from pneumonia a few days later. This was evidently a case of bad judgment on the part of the machine men who did the scaling. The ground was bad, but there was no reason why it could not have been properly scaled and made safe.

At the Creighton mine, on March 12th, a blockholer, Joseph Durat, was struck by a small piece of rock which fell from the back of stope 15, tenth level. Scaling was in progress at the time, and Durat, without any apparent reason, walked under the unsealed portion towards the manway. He received severe injuries in the region of the thigh and backbone, resulting in death March 16th.

Shaft Accidents

Four men were killed in shaft accidents during the year. At the Sylvanite mine, April 10th, an Austrian fell about twenty-five feet from a set of timbers to the bottom of the shaft. This accident was due to carelessness in using 7/8-inch instead of 3/4-inch nuts on 3/4-inch hanging rods, allowing wall plate to drop down.

Harry Yates, a Canadian, fell down the shaft from the third to the fifth level of the Levack mine, April 19th. Yates was employed as underground hoistman and had stepped out on a plank to shake the cable and attract the attention of the men below. In returning to the station he in some manner slipped from the plank and fell to the bottom.

Dalton Boomer was killed at the Jupiter shaft, McIntyre mines, on August 22nd. Boomer was one of a sinking crew and had returned to the bottom after

personally cleaning down the last three sets after a blast. He was an exceptionally careful miner, but in some way a small block of timber, used for wedging wall plates, had been loosely placed behind the lagging, and became dislodged when the crosshead struck the stop blocks.

At the McKinley-Darragh mine, on September 29th, a Russian was knocked from the skip at the loading pocket at the 300-foot level and fell to the 400-foot station.

Accidents from Explosives

Four fatalities underground, due to explosives, occurred in 1917. This is a reduction over previous years, due to greater care in the handling and storage of explosives, reporting of missed holes, etc. The Dome Lake accident on May 16th could probably have been prevented had the shift boss sent a helper with the young Austrian, who was killed, to assist in loading and firing the rounds.

The Bulgarian blockholer at the Creighton mine, on May 30th, prepared three sand blasts, waited for two to explode, and walked into the third blast.

The Hollinger accident, on August 31st, was due to the inexperience of deceased, who remained in a ladderway a short distance from a pop shot he had placed and lighted himself.

At the Crean Hill mine, on December 4th, an Austrian miner walked into a blast on the 528 sub-level. All approaches were guarded, and deceased had been warned with the other men, and how he got back to the face unnoticed is unknown.

Miscellaneous Accidents Underground

Seven fatalities, or 36.8 per cent. of the total accidents underground in 1917, may be classified under this heading. Four of these occurred in the large nickel mines of the Sudbury district, one at the Coniagas, one at the Teck-Hughes, and one at the Hollinger. Ore falling from chute, and being crushed between car and chute, accounted for two at the Creighton. The Crean Hill accident, on October 3rd, was due entirely to the use of a grab hook with a chain sling in lowering material, and this should be universally forbidden.

The Coniagas accident, on August 25th, was due to a stull breaking and permitting workman, who was crossing over an abandoned stope, to fall to the ore below, a distance of twenty-five feet. This timber had been in place two or three years and showed no signs of decay.

A second accident due to improper fastening of material when hoisting in a raise caused the death of a miner at the Crean Hill mine on January 2nd.

Falling down an ore pass at the Acme mine, of the Hollinger Consolidated Gold Mines, caused a fatality on December 11th, and at the Teck-Hughes, Kirkland Lake, a Finn named Hemmi, was struck by a large piece of ore rolling down the stope, receiving injuries which resulted fatally September 26th, six weeks after the accident.

Surface Accidents

Seven men were killed in surface accidents at the mines, six at metallurgical plants, and four at quarries during the year, making a total of seventeen fatalities on surface, as compared with nineteen underground, where it might be assumed

that the risk was considerably greater. At the mines the causes were various, only two being due to transportation. At the Hollinger, on October 20th, a workman stepped in front of a loaded skip on the tramway from the Central shaft to the mill; and at the Miller-Lake O'Brien the driver in charge of the small locomotive accidentally slipped under the front trucks and received injuries which resulted fatally.

A rather peculiar accident occurred at the Casey-Cobalt, where the hoistman was killed December 7th. The counterweight stuck in the guides and allowed the counterweight cable to slack down on the ground when the hoist was started. The hoistman was evidently stooping over the cable when the weight fell and threw him into the air. It is obvious that he should have reversed his engine and taken up the slack before leaving the engine room.

Other accidents on surface occurred: the causes were of the usual nature.

At the smelters and blast furnaces only one death occurred from asphyxiation, which is a very good showing. Railway cars in the yards accounted for two fatalities.

Two quarries furnished four fatalities, or 23.5 per cent. of the total surface accidents.

At the Bruce Mines trap rock quarry, on June 25th, two men were killed by an explosion of five cases of dynamite which were stored in an old shed near the working face. The cause of the explosion is unknown, but it is apparent that the accident would not have occurred had the magazine been removed to a proper distance from the quarry.

At the Dominion mines and quarries, at East Neebish, two fatal accidents occurred, one by fall of rock from the face, August 7th, and the other on June 29th, when an Austrian workman was caught in a conveyor belt.

Prosecutions

John Osmak, an Austrian, employed at the Garson mine of the Mond Nickel Company, was sentenced to three months in gaol at Sudbury on April 15th last for tampering with the bell signals in the Garson main shaft.

Table of Fatal Accidents in

No.	Date 1917	Name of Mine.	Name of Owner.	Name of Deceased.	Occupation of Deceased.
1	July 30	Baldwin	Baldwin Gold Mining Co.	Stephen Powers ..	Foreman .....
2	Jan. 2	Crean Hill	Canadian Copper Co. ..	Anti Tainen	Machine helper.
3	Mar. 12	Creighton	do do ..	Joseph Durak ...	Blockholer ....
4	May 30	do	do do ..	Simeon Michaleff.	do ....
5	July 12	do	do do ..	C. Nicholoff	Chute blaster .
6	July 24	do	do do ..	M. Storazuk	Trammer .....
7	Oct. 3	Crean Hill	do do ..	J. Chirkoski	Timberman ...
8	Dec. 4	do	do do ..	M. Bilinski	Trammer .....
9	Dec. 9	Casey Cobalt	Casey Cobalt Silver Mining Co.	H. Patriquin	Hoistman .....
10	Aug. 25	Coniagas	Coniagas Mines, Ltd. ..	A. Hakkala	Machine helper.
11	Aug. 25	do	do do ..	J. McAlpine	Millman .....
12	May 16	Dome Lake	Dome Lake Mining and Milling Co.	H. Filyx	Machine runner
13	Aug. 31	Hollinger	Hollinger Consolidated .	W. Dilinski	do do
14	Oct. 20	do	Gold Mines, Ltd.	F. Papin	Mechanic .....
15	Dec. 11	do	do do	G. Solentre	Trammer .....
16	July 14	Hudson Bay	Hudson Bay Mines, Ltd.	T. Bond	Teamster .....
17	Aug. 22	McIntyre	McIntyre Porcupine Mines, Ltd.	D. Boomer	Machine runner
18	Sept. 29	McKinley-Darragh	McKinley - Darragh-Savage Mines, Ltd.	N. Kirischuk	Trammer .....
19	Oct. 20	Miller Lake	Miller-Lake O'Brien	H. Hutt	Engineer .....
20	Mar. 18	Garson	Mond Nickel Co.	J. Kulyczyaki	Trammer .....
21	Apr. 19	Levack	do do	H. Yates	Hoistman .....
22	Jan. 12	Nipissing	Nipissing Mines, Ltd..	J. David	Machine helper.
		do	do do ..	L. Lauzon	do do
23	Apr. 10	Sylvanite	Sylvanite Gold Mines..	L. Gruby	Machine runner
24	Aug. 18	Teck-Hughes	Teck-Hughes Gold Mines	J. Hemmi	do do
25	Apr. 17	Trethewey	Trethewey Silver Cobalt Mine	A. De Leury	Trammer .....

Table of Fatal Accidents at

No.	Date 1917	Name of Works.	Name of Owner.	Name of Deceased.	Occupation of Deceased.
26	Jan. 23	Blast furnace	Algoma Steel Corp'n....	E. Prevost	Stove tender ..
27	Feb. 20	do do ..	do do	T. St. Jules	Labourer .....
28	July 7	do do ..	do do	R. Elder	Foreman .....
29	Feb. 24	Reverberatory ...	Canadian Copper Co. ..	G. Danis	Coal dryer.....
30	Jan. 24	Smelter	Mond Nickel Co.	J. Gardy	Ladle man ....
31	Feb. 21	Smelter yard	do do	A. Beauvois	Labourer .....

Table of Fatal Accidents

32	June 25	Quarry	Bruce Mines, Trap Rock Quarry	J. Devell	Machine runner
	do	do	do do	Chas. Munroe	Machine helper.
33	June 29	do	Dominion Mines and Quarries	I. Kuryi	Labourer .....
34	Aug. 7	do	do do	C. Bennett	Machine runner

or about the Mines, 1917

Nationality of Deceased.	Age.	Married or single.	Below ground.	Above ground.	Cause of Accident.
English-speaking ...	55	M	.....	1	Slide of lumber from loaded car.
Finn	25	S	1	.....	Struck by falling timber in raise.
German	39	M	1	.....	Caught by fall of rock in stope.
Bulgarian	30	M	1	.....	Returned before all sand blasts had exploded.
do	28	M	1	.....	Went into hung-up chute to blast.
Austrian	20	S	1	.....	Crushed between chute timber and train. Died August 11 from pneumonia.
English-speaking ...	26	M	1	.....	Fell down raise while helping to lower truck.
Austrian	33	M	1	.....	Walked into blast.
English-speaking ...	32	M	.....	1	Struck by cable of counter-weight.
Finn	30	M	1	.....	Fell about 25 feet when lagging broke.
English-speaking ...	36	M	.....	1	Killed while replacing belt.
Austrian	28	M	1	.....	Killed by explosion while blasting round.
Russian	24	S	1	.....	Struck by rock from blast.
English-speaking ...	39	S	.....	1	Struck by skip on tramway to mill.
Italian	43	S	1	.....	Fell down ore pass while dumping car.
English-speaking ...	47	M	.....	1	Kicked by horse while unhitching.
do do ...	35	M	1	.....	Struck by block of timber in shaft.
Russian	32	S	1	.....	Killed while riding skip.
English-speaking ...	30	M	.....	1	Slipped and fell under locomotive.
Austrian	43	S	.....	1	Thrown over dump while dumping car.
English-speaking ...	32	M	1	.....	Fell down shaft.
do do ...	36	M	1	.....	Caught by fall of rock while scaling in winze.
do do ...	24	S	1	.....	Same accident as above. Died from pneumonia Jan. 19.
Austrian	25	S	1	.....	Fell while timbering in shaft.
Finn	36	M	1	.....	Struck by rock rolling down pile. Died Sept. 26, 1917.
English-speaking ...	25	S	1	.....	Caught by fall of rock in stope.

Metallurgical Works, 1917

Nationality of Deceased.	Age.	Married or Single.	Cause of Accident.
English-speaking ...	24	S	Bolt closing door of stove broke when nut was being tightened.
do do ...	59	M	Run over by railroad car.
do do ...	58	M	Asphyxiated in gas-washing building.
do do ...	28	S	Fell from platform.
Austrian	23	S	Crushed by ladle.
English-speaking ...	19	S	Crushed against platform by passenger coach.

at Quarries, 1917

English-speaking ...	30	M	Powder in shed near men exploded.
do do ...	28	S	Same accident as above.
Austrian	45	M	Wound around drive shaft of conveyor belt.
English-speaking ...	44	M	Fall of rock from face of quarry.

MINES OF ONTARIO

Chief Inspector of Mines, T. F. Sutherland, Toronto; Inspectors, E. A. Collins, Cobalt; J. H. Stovel, Sudbury

I.—NORTHWESTERN ONTARIO

Iron Pyrites

Minitaki Lake.—James Whalen, of Port Arthur, did some work on his pyrites deposit, which is situated on the shore of Lake Minitaki, about 12 miles south, by water route, from Graham station, on the Canadian Government railways. The only outcrop on this claim occurs under the water. A shaft was sunk in the foot-wall to a depth of 75 feet, and a cross-cut run to the vein. Work was discontinued in October, 1917.

Northern Pyrites Mine.—Shipments from this property of the Nichols Chemical Company, Limited, at Northpines, during the season of 1917 amounted to 115,000 tons of pyrites. Ore is shipped only during the navigation season, and is sent from Northpines by rail to Fort William, thence by boat to the various manufacturing plants of the General Chemical Company in the United States. Mining operations are continuous throughout the year. In the winter months the excess ore broken in the mine is stock-piled at the rail-shipping point of the Canadian Government lines.

The production of 1917 was principally obtained from the third level east stopes. Development drifts were run both east and west on the fourth level. The shaft was sunk to a depth of 550 feet, on a 55° incline, and a station cut on the fifth level. It is planned to make such changes in the present equipment as will enable a large tonnage to be shipped in 1918.

G. B. Holderer was superintendent during the shipping season, and was succeeded in November by J. A. Battle, Jr. From 200 to 250 men were employed.

Mokomon.—The Nichols Chemical Company, Limited, concluded their diamond-drilling on the pyrites prospect at Mokomon, in Conmee township, during November, 1917. It is expected that the company will acquire this property. Dr. Warren S. Smith was in charge of the exploration work.

Copper

Port Arthur Copper Company.—This company did a small amount of development work on their property, which is situated south of the main line of the Canadian Northern railway, about four miles west of Mine Centre.

In October, 1917, a 100-h.p. boiler, a 500-cu. ft. air compressor and a 10 by 12-inch steam hoist were being installed. The shaft, a two-compartment one inclined at 80°, had been sunk to a depth of 55 feet. It was planned to sink farther and do considerable drifting as soon as the headframe and hoist were ready.

The company has a capitalization of $2,500,000. The officers of the company are: Fred M. Connell, of Toronto, president; J. F. Hewitson, of Port Arthur, vice-president; J. A. M. Alley, 904 Bank of Hamilton Building, Toronto, secretary-treasurer.

W. H. Connell was manager, employing about 15 men.

Tip Top Mine.—S. W. Ray, of Port Arthur, re-opened the Tip Top mine in 1917, shipping to the Trail smelter in British Columbia. The mine is located about 6½ miles south of the main line of the Canadian Northern railway from a point two miles west of Kashaboiwe station.

A narrow-gauge track was laid from the mine to the railway and the ore cars are hauled over this by a dinkey locomotive. The mine had previously been opened to a depth of 200 feet and drifts run every 50 feet of depth. Only the first and second levels (50 and 100-foot depths) had been de-watered up to October, 1917, the ore produced having come from above these levels. At that time the mine was shipping about 15 tons daily.

S. W. Ray, of Porth Arthur, is owner and operator, Mr. Flatt being in charge at the mine: 10 men were employed.

Gold

St. Anthony Mine.—The Thunder Mining Company continued development work on the St. Anthony mine until September, 1917, when the property was closed down for the winter months. Development work done by this company consisted of 1,500 feet of drifting, 100 feet of raising, and 150 feet of sinking. The mill was run for a short time for sampling purposes.

The Kerr Lake Mining Company, which operates the well-known silver mine of this name at Cobalt, holds approximately two-ninths' interest in the new company.

H. H. Lavery was superintendent, employing 60 men.

Rognon.—The Rognon Gold Mines, Limited, commenced operations in June, 1917, on the Rognon claim, which is situated on Contact bay, Wabigoon lake, about eight miles south of Dryden. A small boiler, compressor and hoist were installed, and 70 feet of sinking, 60 feet of drifting and 50 feet of raising done. A single Nissen stamp, with amalgamating plates, was installed and used for testing purposes.

The company is capitalized at $2,500,000. J. M. Beckley, Rochester, N.Y., is president; S. J. Madden, Toronto, vice-president and manager; and J. R. L. Starr, Toronto, secretary. S. J. Madden was in charge and employed about 10 men.

Tash Ore.—The description of this property, contained in the Bureau's Twenty-sixth Report, represented the work done up to June, 1917. The mine was closed shortly afterwards and has not been re-opened.

II.—SUDBURY, NORTH SHORE AND MICHIPICOTEN

Iron Ore

Helen Mine.—Operations at this mine, owned by the Algoma Steel Corporation, consisted in drawing off the caved hematite ore. At the end of 1917 only a portion of the seventh level and a small area on the eighth level remained to be drawn off, so that it seems probable that the Helen hematite ore body will be finished early in 1918. All ore hoisted was shipped to the Magpie mine, where it is roasted to eliminate the high sulphur content. During 1917, 2,825 tons of pyrites were mined and 99,238 tons of hematite.

In October, 1917, preparations were being made to drive a development tunnel underneath the large siderite deposit at this mine, which was diamond-drilled in 1916 and 1917. This deposit adjoins and also underlies the original hematite ore body. The entrance to the tunnel will be on the north side of the hill or deposit which is farthest from the present mine buildings. This tunnel will tap the ore body about 300 feet below the top of the hill, and a large tonnage will be available above it. It is planned to mine the portion of the ore body above the tunnel by open-pit method. Electric haulage to the roasting plant, which will be erected not far from the tunnel entrance, will be used.

G. R. McLaren, Helen Mine, Ont., is superintendent. About 100 men were employed.

Magpie.—The Magpie mine of the Algoma Steel Corporation produced 184,592 tons of roasted ore during 1917, and shipped 197,561 tons. Scarcity of labour prevented the mine from being operated to full capacity. The ore produced came from the second and third level stopes. Considerable development was done on the fourth level during the year. In the summer this mine, as well as the Helen mine of the same company, was put on an eight-hour working basis for underground work.

A. Hasselbring, general superintendent of mines for the company, is in charge at the Magpie mine. From 200 to 230 men were employed.

Dreany Bros.—Dreany Bros., of Toronto, did some surface stripping and trenching on a banded magnetite iron deposit near the Algoma Central railway, four miles north of Goudreau. Further testing was to be done by diamond-drilling. C. D. Daimpre was in charge.

Rand Pyrite Mine.—Early in 1917 the Rand Consolidated Mines, Limited, commenced opening up a pyrite deposit near Goudreau station, on the Algoma Central railway. Considerable surface work was done during the year and a trial shipment of two cars made. A 250-h.p. boiler had been installed, and a crusher and compressor were being put in.

The company is incorporated with a capitalization of $5,000,000, but permanent officers have not been elected. Allan W. Jackson, of Goudreau, was manager; about 25 men were employed.

Grace Gold Mine.—The Grace mine, a former gold producer, situated not far from Wawa station, on the Michipicoten branch of the Algoma Central railway, was pumped out during the latter part of 1917. The work was done for a Pittsburg (Pa.) syndicate, Robt. Patterson being in charge. No mining was done.

Nickel and Copper

The Canadian Copper Company

The Canadian Copper Company operated during 1917 the following mines: Creighton, Crean Hill and Dill quartz quarry.

The officials of the company are: President, A. D. Miles; general superintendent, J. L. Agnew; superintendent of mines, J. C. Nicholls; smelter superintendent, W. Kent; chief engineer, E. H. Jones; safety engineer, E. T. Corkill.

Copper Cliff Smelter.—The smelting capacity was enlarged by the addition of another furnace, No. 8. This furnace is the same size as No. 7, 25 ft. 6 in. by 50 in. The smelting capacity was further increased by the lowering and enlarging

One of the sorting floors, Creighton mine rock house.

of all the settlers. By this change the slag from the converters can be poured directly into the settlers instead of being sent to the furnaces. A sixth converter was added.

Creighton Mine.—During 1917 the Creighton mine shipped 1,003,816 tons of ore. Work was carried on in all levels from the second to the fourteenth, the main production coming from the tenth and twelfth levels. Most of the breaking was done in the twelfth level stopes. The fourteenth level was opened up by cross-cuts, and other development and stoping begun. The work above the tenth level was scattered over miscellaneous areas. During the first part of the year No. 3 shaft was completed and put into commission.

In the Twenty-sixth Report of the Bureau of Mines a description is given of the shaft, rock house, hoisting house and equipment, compressor equipment and change house; these have all been put into use during 1917.

All ore is now hoisted through No. 3 shaft and treated in the new rock house.

In No. 2 shaft two cages are used for handling men and material to the upper levels. The timbering and other equipment in No. 1 shaft were removed, and work was commenced to break the ore which surrounds a part of this shaft.

The new construction, begun two years ago, is completed, and this equipment is handling the increased output through one shaft and sorting plant, instead of through three shafts as during the previous year.

G. A. Morrison is superintendent: about 1,100 men are employed.

Part of washroom in change house, Creighton mine.

Vermilion Mine.—This property was closed down in January, 1917. No shipments were made last year.

Dill Quartz Quarry.—This quarry was operated from April to November of 1917, and shipped 61,584 tons of quartz to the smelter at Copper Cliff.

A small steam shovel was operated in this pit during a portion of the year.

H. Whitehead, who was superintendent at the beginning of the season, joined the Canadian Naval Service, and was succeeded by W. H. Roach. Forty-five men were employed.

No. 2 Mine.—This property was closed down at the end of January, 1917. The ore produced was 1,906 tons. W. J. Hambly was superintendent.

Crean Hill Mine.—The output for 1917 was obtained principally from the fifth and second levels, and amounted to 133,907 tons.

C. Collins is superintendent, employing from 250 to 300 men.

British America Nickel Corporation

The British America Nickel Corporation continued the development of the Murray mine, and began building operations on the smelter site during 1917.

The authorized capital stock of the corporation is $20,000,000, divided into 200,000 shares of common stock of a par value of $100.

View showing arrangement of lockers in change house, Creighton mine.

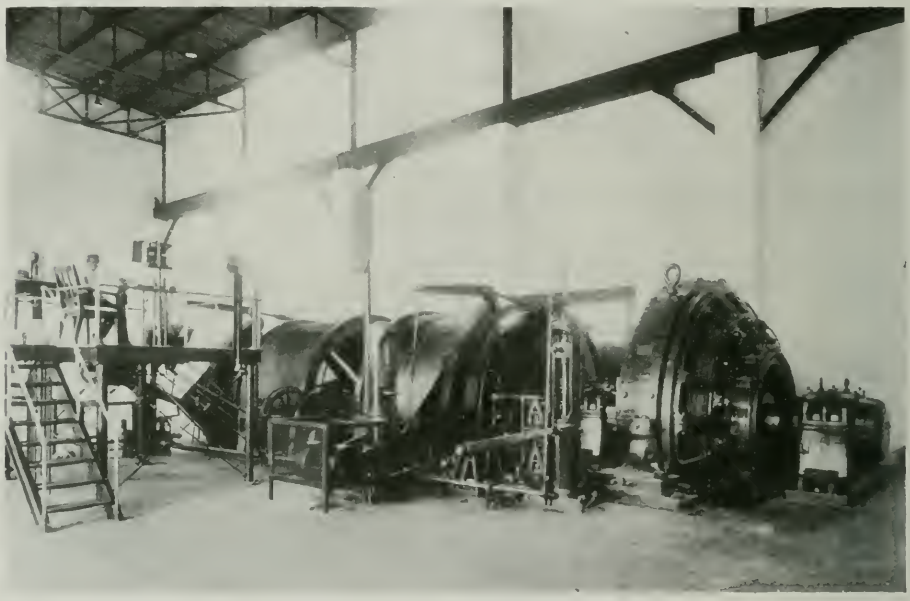
The officers of the company are: President, J. H. Dunn; vice-president, W. A Carlyle; secretary and treasurer, W. H. Coade; general manager, E. P. Mathewson. The head office is at the Royal Bank Building, Toronto.

In the spring of 1918, E. P. Mathewson severed his connection with the company, and W. A. Carlyle assumed the duties of manager. The head office was moved from Toronto to Ottawa, and the construction of a refinery was commenced near Hull on the Quebec side of the Ottawa river.

Murray Mine.—At the Murray mine the 3-compartment incline shaft was continued to the 900-foot level, with levels at 150, 300, 400, 500, 600, 700, and 800 feet, and ore pockets at the 300, 500, and 700-foot levels.

A shaft house is under construction. This building is of steel and reinforced concrete 60 feet by 64 feet, and is 102 feet high. The crusher is 36 inches by 48 inches. The waste bin is 400-ton and the ore bin 500-ton capacity.

From the shaft house the ore is conveyed by a 30-inch travelling belt to the rock house, a distance of 279 feet. The rock house is 88 ft. by 126 ft. of steel and gunnite construction on a concrete foundation. The bins are of reinforced concrete.



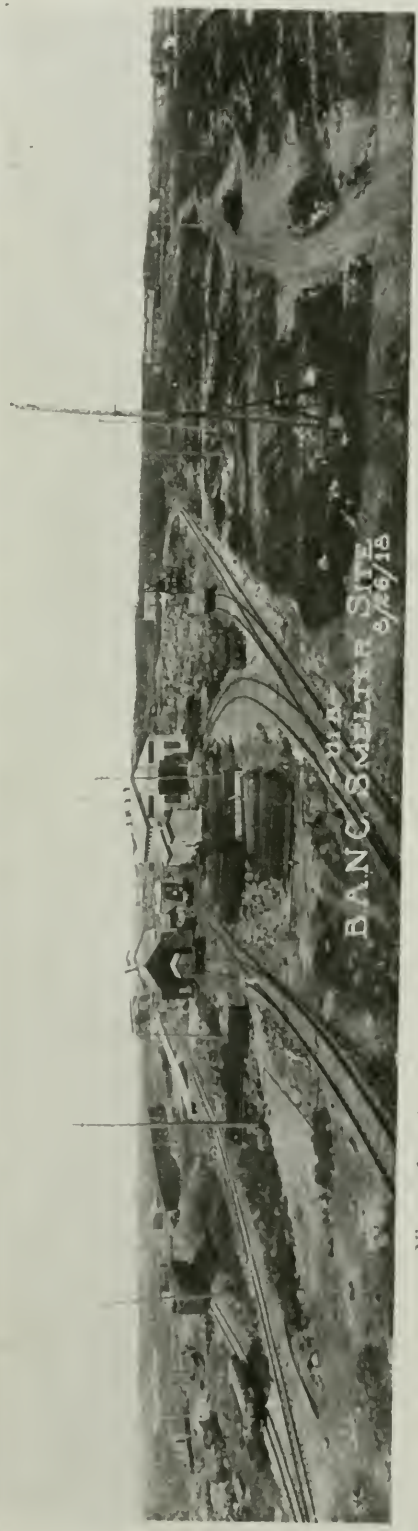
Ore hoist at Creighton mine.

The equipment comprises a 36-in. by 18-in. jaw crusher, a No. 5 gyrating crusher, picking belts, screens, etc. A one-storey brick change house, 97 ft. by 57 ft., is nearly completed. The power house at the mine is 107 ft. by 134 ft. The installation will include three 500-h.p. Babcock and Wilcox boilers.

Smelter.—The smelter site is 1¼ miles from the mine. Eight miles of standard-gauge railroad have been built, connecting the mine with smelter yards. These tracks are connected with both the Algoma Eastern and Canadian Pacific railways.

The smelter buildings completed and those under construction include a warehouse 41 ft. by 144 ft. of steel and gunnite; machine shop, including boiler shop 50 ft. by 160 ft. of steel and gunnite; change house, 57 ft. by 113 ft., of reinforced concrete and brick; power house, 198 ft. by 83 ft., of steel and brick; smelter building, 378 ft. by 67 ft.; dust chambers, 77 ft. by 120 ft., of brick and steel.

The equipment in the power house will include six Babcock and Wilcox boilers and two 2,500-cu. ft. Bellis and Morcum air compressors.



Views of smelter at Murray mine under construction by the British America Nickel Corporation.

Shaft house, Murray mine.

Rock house, Murray mine.

General view of Murray mine, showing shaft house in centre and rock house on right, British America Nickel Corporation.

Mond Nickel Company, Limited

The Mond Nickel Company, Limited, operated in 1917 the Victoria, Garson, Worthington and Levack mines, in the Sudbury field, and Bruce Mines, situated in the village of that name.

The head offices of the company in Canada are at Coniston. The officials are: C. V. Corless, manager and also a director of the company; J. F. Robertson, superintendent of reduction works; O. Hall, mines superintendent; W. L. Dethloff, chief engineer; W. H. Soule, electrical superintendent.

Bruce.—No. 1 mine shipped 32,500 tons to the smelter in 1917. The shaft was continued to the fifth level, a depth of 427 feet. A drift is being run from this point to connect with the workings at the bottom of the old No. 2 shaft, and it is planned to prospect this area more thoroughly.

At the No. 2 mine, formerly the Taylor shaft, development was continued on the 150-foot level during the year. About 1,000 feet of drift was driven. No stoping was done.

A. D. Carmichael, Bruce Mines, is superintendent. From 75 to 85 men were employed.

Garson.—The output from this mine in 1917 was 117,000 tons, this ore being obtained principally from the sixth level stopes. Development on the eighth level was continued and several stopes were prepared for mining by section-cutting on the sub-level. Development on the tenth level was confined to drifting and cross-cutting. The drifting, cross-cutting and raising done in the mine during the year was 4,000 feet. J. R. Thoenen is superintendent. About 300 men were employed.

Levack.—The Levack mine shipped 88,500 tons of ore to the smelter in 1917. This ore was mainly obtained from the second and third level stopes. During the year development was continued on the fifth level. The shaft, which is inclined at 65 degrees from the horizontal, was sunk to the seventh level, a vertical depth of 590 feet, and a station was cut at the seventh level. A club house and 13 more cottages were erected in the company village.

F. J. Eager is superintendent. About 300 men were employed.

Victoria No. 1.—This is still the deepest mine in Ontario. The shaft was 2,750 feet in depth at the end of the year 1917, and was to be continued to the 3,000-foot level before another station was cut. The mine produced in 1917 16,000 tons of ore. Stoping was carried on in nearly every level.

W. J. Mumford is superintendent: 115 men were employed.

Worthington.—This mine shipped 75,000 tons of ore to the smelter in 1917. Stoping was carried on above the second and third levels. The fourth level was developed by drifts and cross-cuts and the stopes opened up by section-cutting on the sub-level. The shaft was continued to a vertical depth of 750 feet, and a fifth level station was cut at that depth.

R. H. Palmer is superintendent: about 275 men were employed.

Reduction Works.—The production of the Coniston smelter during 1917 was about the same as in 1916. Two furnaces and two converters were operated con-

tinuously; the sintering plant and the concentrating test plant ran steadily. The roasting of ore in the roast yards was again confined to the late autumn and winter months.

An additional furnace and converter, with the necessary auxiliary equipment, were under construction and should be ready for operation early in 1918. The smelter will then have four furnaces and converters, so that the production of matte can be largely increased, when desired.

J. F. Robertson is superintendent of all reduction works; E. T. Austin, superintendent of the smelter; K. S. Clarke, superintendent of the sintering and concentrating plants.

Safety Organization.—At the Coniston reduction works safety matters are in the hands of two committees: Supervising, and Auxiliary. The former committee decides what changes are to be made. The chairman is the manager of the company, and the secretary is the head of the office staff. The six other members are the heads of departments together with the men next under them in direct charge of the work, viz.: the superintendents of reduction works, smelter, sintering and test plants, representing operations, and the chief engineer and mechanical and electrical superintendents, representing construction, maintenance and repair. These six men act in rotation as chairman of the auxiliary committee, the other members of which are foremen, sub-foremen or workmen, one from each of the following: Smelter, sintering and test plants, mechanical and electrical departments, and yard, each being selected by his own superintendent. Three of the members of the auxiliary committee are changed every fortnight, *i.e.*, each is a member for four weeks; thus in a short time a very considerable number of the men in the plant have been members of this committee. The inspection is in the hands of this committee, every second Monday afternoon being devoted to the work. Each unsafe practice, or unsafe piece of equipment detected, is made the subject of a brief report on a printed form, this report containing a recommendation as to the manner of removing the danger.

The supervising committee meets next day, and the reports of the auxiliary committee are presented by the member of the supervising committee who has acted as chairman of the auxiliary committee. After the reports are discussed a decision is made as to what action shall be taken. Practically all recommendations of the auxiliary committee have been passed as received, three or four only having been set aside as unnecessary, and a few amended as to the methods of eliminating the danger; no recommendation has been overruled on account of cost. The supervising committee also discusses recommendations from any of its own members and from a suggestion box hung near the time-check wicket. Once a month the accidents which have occurred during the preceding months are discussed, and the records compared with those of former periods. Should a serious accident occur, the auxiliary committee meets as soon as practicable and investigates, reporting to the supervising committee.

The above organization for safety has worked very effectively and smoothly. It has now been in operation for eighteen months, and the decrease in the number of accidents has been very marked.

The only change in procedure has been the reduction of the number of inspections and meetings from weekly to fortnightly after most of the points needing attention had been remedied.

The committee realizes the responsibility of its work. An important part of the scheme is the rotation of the foremen, sub-foremen and workmen through the auxiliary (*i.e.,* inspecting) committee. Each man goes through his own and other parts of the plant devoting all his attention to safety considerations, in most cases carrying back to his work a great deal of the safety point of view. The more important men are put on the auxiliary committee again after a considerable interval.

Another point in the same connection is the absence of any division of authority. The foreman, or sub-foreman, the man who must get the work done quickly and cheaply, is also, or has been, a member of the safety committee to make that work safe, and he knows that his superintendent is a member of the safety organization all the time and is depending on him, the foreman, to help keep the number of accidents at a minimum.

Miscellaneous Mines

Goudreau Pyrite.—The Nichols Chemical Company shipped from their mine at Goudreau, during the season of 1917, 110,000 tons of pyrites. Ore is shipped only during the navigation season, by rail from Goudreau to Michipicoten Harbor, and thence by boat to the various plants of the General Chemical Company in the United States. The ore shipped in 1917 was obtained from "C" deposit, which was the first opened and is about 1,000 feet from the mill. In the autumn of 1917 a second deposit, known as the "Bear," was being prepared for production in 1918. This deposit is over a mile from the crushing plant, and the ore from it will be handled to the mill over a narrow-gauge track. The crushing plant is being almost entirely changed, and the new installation includes a No. 12-K Gates gyratory crusher, which will greatly increase future production.

J. A. Battle, Jr., was superintendent until October, 1917, when he was transferred to the Northern Pyrites mine, which is also one of the properties of the Nichols Chemical Company, Limited. He was succeeded by Gerald G. Dobbs. About 200 men were employed throughout the season.

McDonald Copper.—The Cheney Copper Mines, Limited, did a small amount of work on the McDonald and Jackson claims, situated on lots 6, 7, 8, 9 and 10, in the fifth concession of Gould township, north of Thessalon. No ore was shipped.

Hudson Copper.—The Hudson Copper Company did some development work on a copper-quartz claim situated about two miles north of Havilah. A shaft 60 feet deep was sunk and considerable surface trenching done in the vein. One car of ore was shipped.

John Black was in charge, five men being employed.

Rutherglen.—The Mattawan River Mining and Milling Company, Limited, sank a 50-foot shaft and did about 50 feet of drifting on a claim which adjoins the main line of the Canadian Pacific railway, about two miles east of Rutherglen. A small boiler, compressor and hoist were installed. The mine was closed down in the autumn of 1917.

Sudbury Copper.—The Sudbury Copper Company, Limited, continued development of their property near Iron Bridge. The shaft was sunk to a depth of 250 feet and a small amount of drifting done on the 150-foot and 250-foot levels. A powder house, change house, and several cottages were built.

George E. Bent, Iron Bridge, was manager; from 15 to 20 men were employed.

Moose Mountain Iron Mine

Moose Mountain, Limited, has an authorized capitalization of $4,000,000 divided into 400,000 shares of a par value of $10.

The officers of the company are: President, Chas. E. Herrmann; secretary-treasurer, Gillison C. Lott; directors, L. B. Miller, Cleveland; John T. Mitchell, Chicago; Donald D. Mann, Toronto; James C. Hutchins, Chicago; Chas. H. Smith, New York; John B. Dennis, New York; William Mackenzie, Toronto; Chas. E. Herrmann, New York; Augustine L. Humes, New York; David Dows, New York; John F. Harris, New York. The head office is at 17 Battery Place, New York.

The mine officials are: A. J. Anderson, general manager; H. H. Hodgkinson, mine superintendent, Sellwood, Ont.

During the year the main tunnel and "B" drift (10 ft. by 11 ft.) was driven 451 feet, and "A" drift (5 ft. by 7 ft.) was driven 339 feet; "A" drift for a distance of 711 feet was enlarged from 5 ft. by 7 ft. to 10 ft. by 11 ft. The other underground work consisted of: winzes, 93 ft.; raises, 9 ft.; raises for chutes, 182 ft.; and level drifts (5 ft. by 7 ft.), 509 ft.; diamond-drilling amounted to 5,170 ft.

Ore sent to the mill amounted to 12,947 tons, of which 4,773 tons came from No. 1 dust pile; 5,500 tons from development work; 2,038 tons from the stopes, No. 2 tunnel; and 636 tons from No. 2 pit.

The results now being obtained in the mill are considered satisfactory by the company. The concentrates are pressed into bricks 8 in. by 4 in. by 2¼ in., weighing 7½ lbs. when burned. In the kilns the bricks are subjected to a maximum temperature of 2,200 F., and are of a sufficient hardness to stand transportation and smelting.

The machinery installed included a No. 86 Marcy mill, an 8 ft. by 36 in. Hardinge mill, a 4-mould No. 701 American clay machinery briquette press, and a 6 ft. by 6 ft. Oliver filter. Additional filters and moulds are being installed.

Quarries

Killarney.—Willmott and Company, of Toronto, sold their quartz quarry, located on Georgian bay, not far from Killarney, to Electro-Metals, Limited, of Welland. It was operated during the season of navigation by Willmott and Company, who had a contract for getting out the quartz. The shipments went to the ferro-silicon plant of Electro-Metals, Limited. Some changes and additions were made to the crushing and conveying machinery.

Dan Chisholm, of Killarney, was in charge, and employed 45 men.

Bruce Mines Trap Rock.—This quarry was operated until midsummer in 1917 by W. S. Edwards, trustee, of Sault Ste. Marie, Mich. The quarry was then shut down because boats to ship the product could not be procured.

E. Mitchell, Bruce Mines, was in charge; about 60 men were employed.

East Neebish Island.—This quarry, owned and operated by the Dominion Mines and Quarries, Limited, shipped 57,000 tons of quartz to Buffalo, N.Y., during the season of navigation. Additional equipment is to be added to enable the company to increase their shipments in 1918.

I. Appleton, of McLennan, was in charge; about 60 men were employed.

III.—DISTRICT OF TIMISKAMING

Gold

Boston Creek and Munro Township

Baldwin.—The Baldwin Gold Mining Company, Limited, owns the north half of lot 2 in the sixth concession of the township of Eby. The shaft and camps are located near the right-of-way at mileage 167½, T. & N. O. railway. Work was carried out at intervals during the year and a vertical shaft sunk to a depth of 100 feet.

The plant included one 65-h.p. portable boiler; one 6 by 8 Jenckes hoist; and a small compressor, 300 cubic feet capacity.

Hugh Baldwin was manager of the mine, employing ten men.

Bourkes Mines.—Bourkes Mines, Limited, did considerable surface prospecting and trenching on their promising discovery near Bourkes station, in the first concession of Benoit township.

The vein strikes north about 20 degrees west, and when inspected on November 15th, 1917, had been open-cut for a distance of 100 feet, and in the vicinity of the original discovery showed considerable free gold.

It was the intention of the company to erect camps and diamond-drill during the winter.

The directors are: Charles Millar, Charles Gentles, and Archie Burton, all of Toronto; Alex. Gillies and John J. Byrne, Bourkes.

Burton-Munro.—Burton-Munro Mines, Limited, worked continuously during the year on their claims situated on the north half of lot 11, in the first concession of Munro township. The incline shaft was sunk to a depth of 318 feet, with stations at the 148 and 300-foot levels. On the first level 96 feet of cross-cutting and drifting was done, and on the bottom level 735 feet. Operations were suspended in February, 1918.

The head office address is 55 Yonge Street, Toronto. The officers and directors are: Charles Millar, president; Charles Gentles, Archie Burton. David Sloan was manager.

Croesus.—With the exception of a temporary shut-down in July, 1917, while the pumping capacity was being increased, the Croesus Gold Mines, Limited, worked continuously throughout the year. Underground development was practically confined to the 300-ft. level, where 700 ft. of cross-cutting and drifting was done. Ore stoped was produced on the two upper levels. The mine was closed down on February 15th, 1918. Julius Cohen, manager, resigned in September, 1917, to join the American overseas forces, and was succeeded by Charles Lobner, who had charge of operations until the mine closed in February.

The officers are: President, D. M. Steindler, New York; vice-president, Mortimer Davis, Montreal; secretary-treasurer, E. L. Steindler, Cobalt. The head office of the company is 42 Broadway, New York.

Hill.—The Hill Gold Mining Company own 160 acres in the township of Beatty, near Painkiller lake, and about seven miles from Matheson. Development began in the autumn of 1917 and a shaft was sunk to a depth of 125 feet. The plant includes two 60-h.p. boilers, one 25-h.p. boiler, and one Rand compressor, capacity 1,200 cubic feet.

A 70-ton mill is in course of erection, and will be ready for operation in the summer of 1918.

The officers are: President, W. H. Hill, Boston; directors, G. Smith, Boston; Senator Bowen, Providence, R.I.; and A. M. McEvoy. J. Hill is mine manager.

Murray-Mogridge.—The Murray-Mogridge Mining Company, Limited, own ten claims on lots four and five in the fifth and sixth concessions in the township of Maisonville. The mine is reached by wagon road from Bourke's station, T. & N.O. railway, a distance of four miles. The camp buildings are erected on the east shore of Wolf Lake.

The officers are: President, C. E. Jury, Toronto; vice-president, W. W. Sloan, Toronto; secretary-treasurer, C. J. Bielby, Toronto; head office, Union Bank Building, Toronto; directors in addition to above officers: F. C. Annesley, D. I. Grant, N. Schaeffer, all of Toronto; and J. J. B. Cooper, New York. Manager, G. G. Thomas, and mine captain, John McCallum.

Active development began on June 15th, 1917, and was continued to the end of the year. When visited in November the shaft had been sunk to a depth of 226 feet with working levels at 50, 100, and 200 feet.

A total of 250 feet of cross-cutting and drifting had been done on the three levels. Twenty-five men were employed.

Miller Independence.—Miller Independence Mines, Limited, carried on active development work throughout the year on their property, south half of lot 1, Concession VI., township of Pacaud. This was a veteran claim, originally owned by English interests, and purchased by F. M. Connell, of Toronto, when gold was discovered in 1915. The claim was then purchased by George J. Miller, of Ohio, who formed the above company. Several shafts have been sunk to varying depths, and the veins carried considerable values in free gold in many places. In the summer of 1918, a discovery was made near the north boundary which carries very

high values in tellurides and free gold, and a shaft designated as "D" shaft had been sunk to a depth of 100 feet in July, 1918. The vein at this point appears to have a definite east and west strike and dips to the south at about 40° from the horizon.

During the year "C" shaft was sunk to a depth of 110 feet, with levels at 44 feet and 100 feet. On the first level 200 feet of drifting was done, and on the 100-foot level cross-cuts were driven 112 feet to the south and 80 feet to the north.

A test mill run of 250 tons was made during the year.

The officers are: President, Geo. J. Miller; vice-president, N. W. Kirkpatrick, Dayton, Ohio; secretary, John C. Schaeffer, Germantown, Ohio; treasurer, Ed. Rettich, Germantown, Ohio; directors, O. B. Brown, Wm. Stroup, Geo. W. Ozias, J. A. Read, and J. A. Beagard, all of Dayton, Ohio.

Patricia Syndicate.—The property of the Patricia Syndicate, formerly known as the Boston-Hollinger, consists of two 40-acre claims in the north half of lot 3, in the sixth concession of the township of Pacaud, one mile south-east of Boston Creek station, on the Timiskaming and Northern Ontario railway.

The property was taken over under option by the Patricia Syndicate on August 15th, 1917.

The mine plant consists of two 50-h.p. locomotive boilers, one Canadian Ingersoll-Rand two-stage air compressor of a capacity of 500-cu. ft. of air per minute, and a Jenckes 6 by 8 hoist.

The work done to date has been confined to two of the 12 known veins; most of this work has been concentrated on the No. 7 vein, which is in the north central part of the west claim. This vein is in the Keewatin series, and strikes east with a dip of 74° south. It has been opened by trenching for a length of 700 feet and a two-compartment shaft has been sunk on it to 215 feet, with stations and pockets at the 100 and 200-ft. levels. On the first level 305 feet of drifting had been done to May 20th, 1918, and three stopes opened out above the level. The 200-foot level is now being opened up in the same manner. The vein consists of two and sometimes three sections of quartz with some calcite lenses on the foot and hanging-wall sides. The ore contains one or two per cent. sulphides, consisting mainly of chalcopyrite and chalcocite with patches of hornblende. The gold is for the most part free and is visible in much of the high-grade ore. The width of vein varies from 8 to 40 inches, with an average width of 26 inches of primary quartz.

The mill has been erected 225 feet north of the "A" shaft, and is now ready for operation. The ore is trammed from the shaft bin in one-ton cars, and as it enters the mill building is weighed on a Fairbanks scale. The ore is crushed in a 9 in. by 15 in. Blake-type crusher fitted with manganese jaw plates, and from there is elevated to the top of the 100-ton ore-storage bin. It passes through a trommel, which is fitted with a punched screen having one-inch openings, and the oversize returns to the crusher bin. From the storage bin it is fed by a belt-driven Challenge feeder to the feed box of the ball-tube mill. This mill is a 5 ft. by 6 ft. Allis-Chalmers type, fitted with cast-iron step-lifter liners. The ball charge is made up of 1, 1½, 2, and 3-inch balls, the total load being 7 tons. From the ball mill the pulp passes over a set of primary amalgamation plates to a Dorr

classifier, where the oversize is elevated to the feed box of the ball mill for further reduction. The undersize (minus 40-mesh) is sent over a set of secondary amalgamation plates and thence to three No. 6 Wilfley tables, where the sulphides are removed. The tailings are impounded for possible treatment at a future time. The concentrates are dried in a steam-drying pan and sacked for shipment to the smelter.

The mill has a capacity of 50 tons daily. Water is obtained from a small lake north of the mill.

Chas. A. O'Connell is manager, employing 50 men.

Kirkland Lake

Active development was carried on in the Kirkland Lake camp in 1917. Operations at the producing mines and development at the prospects received a decided impetus by the delivery of electric power early in the spring. Mill construction at the Kirkland Lake Gold Mines, Limited, operated by the Beaver Consolidated Mines, Limited, of Cobalt, was stopped after the foundations were in place in December, 1917, but it is stated that this mill will be completed during 1918. The Lake Shore company erected a 75-ton mill and made the first run on March 8, 1918.

Burnside.—Early in 1918, the Aladdin Cobalt Mining Company, Limited, acquired an interest in the Burnside Gold Mines, Limited, and began active development of the property adjoining the Tough-Oakes.

No. 2 shaft, 90 feet deep, was pumped out and re-timbered, and No. 3 shaft was down to a depth of 85 feet when visited in April, 1918.

Two upright boilers were installed for hoisting purposes, and air was supplied by the plant of Sylvanite Gold Mines, Limited. Charles Richardson, of the Aladdin Company, is manager.

Canadian Kirkland.—The Canadian Kirkland Gold Mines, Limited, own four claims in the township of Teck, known locally as the Killoran claims. Prospecting was started in January, 1917, under the direction of Robert R. Tough, and carried on throughout the year. Work consisted of trenching, sinking of test pits on several veins, and the erection of boarding camps. Rocks of the Cobalt series are found in this district, with the porphyry intrusives typical of the formation farther east.

When visited in March, 1918, surface prospecting was still being carried on, with the expectation of installing a mining plant in the summer of 1918.

The officers are: President, A. A. Amos, Cobalt; vice-president, George Tough, Haileybury; secretary-treasurer, G. T. Ware, Haileybury. The board of directors includes the above officers: W. E. Smith, Toronto, and B. G. Killoran, Haileybury.

Elliott-Kirkland.—Work was continued throughout the year on the two claims L1616 and L1617 in the township of Teck, owned by the Elliott Kirkland Gold Mines, Limited. On March 23rd, 1918, the shaft was 433 feet deep, with levels at 120, 220, 320, and 420 feet. The following work was done during the year:—

First level, cross-cutting 184 feet.

Second level, cross-cutting 60 feet.

Third level, cross-cutting 71 feet, drifting 158 feet.

Fourth level, cross-cutting to south 70 feet, drifting east 27 feet, drifting west 92 feet.

About 75 feet from the cross-cut in the west drift, fourth level, a well-defined vein carrying gold values was encountered in March, 1918. Considerable importance was attached to this discovery, as it extended the mineralized area for a considerable distance to the west.

The officers are: President, S. Harry Worth, Philadelphia; vice-president and managing director, R. H. Lyman, Cobalt; secretary, W. A. Gordon, Haileybury. The board of directors includes the above officers; John Wood, 801 Bank of Hamilton Building, Toronto, and E. W. Kearney, Haileybury. Thirty-five men were employed.

Fisher.—The Fisher Gold Mining and Milling Company, Limited (head office, Royal Bank Building, Toronto) did considerable surface trenching and development on their claims in Teck township. In November, 1917, camps were built and preparations were in progress for active development, shaft-sinking, and plant installation. Nothing further was done during the year.

The officers are: President, L. G. Glass, Montreal; secretary-treasurer, John A. Sullivan; manager, S. C. McLaughlin.

Kirkland Lake.—Before closing down, on December 31st, 1917, the Kirkland Lake Gold Mining Company, Limited, completed the main shaft to the 700-foot level, and performed a large amount of development work on the four lower levels. No. 2 shaft, which is more centrally located for mining purposes, was sunk to a depth of 150 feet. The foundations for a 100-ton mill were erected, three electrically operated Aldrich pumps installed, and everything left in readiness for development on a much larger scale when financial arrangements were completed.

Operations were in charge of Frank L. Culver and W. J. Moffatt, of the Beaver Consolidated Mines, Limited; Jay Elliott is resident superintendent, employing 60 men.

The Beaver Consolidated Mines, Limited, owns 1,743,050 shares of this company's stock. Approximately 8,000 tons of ore have been mined from development and are now on the surface ready for milling.

Kirkland Porphyry.—The Kirkland Porphyry Gold Mines, Limited, continued development of their property lying between the Teck-Hughes and Kirkland Lake mines. The shaft was sunk to a depth of 280 feet, and a small amount of cross-cutting and drifting done at the 150-foot and 280-foot levels. The vein was encountered at both levels, and values were sufficiently high to ensure further development. Twenty-five men were employed under the management of H. Cecil.

Lake Shore.—Active development was carried on throughout the year by the Lake Shore Mines, Limited. The main shaft was sunk to the 400-foot level, both No. 1 and No. 2 veins having been explored on this level.

Development work for the year ending November 30th, 1917, may be summed up as follows:—

Drifting and cross-cutting	200-foot level	2,000	feet.
" "	100 " "	200	"
" "	300 " "	250	"
" "	400 " "	180	"
Sinking shafts and sumps		150	"
Raising		85	"
	Total	2,865	feet.

Construction work on the new mill started September 1st, 1917, and the first run was made on March 8th, 1918. The ball and tube mill grinding plant has a capacity of 65 tons per day, and the cyanide end of the mill is equipped to treat 100 to 125 tons per day. The grinding capacity may be increased as desired without interference with the operations of the mill.

The officers are: President and managing director, Harry Oakes; vice-president, Arthur G. Slaght; treasurer, Dr. Conrad E. Wettlaufer; secretary, Kirkland Securities Corporation, Limited.

John W. Morrison was manager during the year. The mill was designed and built under the direction of D. J. Coffey, who succeeded Mr. Morrison as manager in April, 1918.

Minaker.—The Minaker Gold Mines, Limited, did a small amount of development on their group of claims lying south of the Lake Shore mine. No. 1 shaft was sunk to a depth of 45 feet, and No. 2 shaft to a depth of 25 feet.

Considerable surface trenching was performed. Work was in charge of T. J. Flynn, employing 5 men.

Sylvanite.—The Sylvanite Gold Mines, Limited, own the following claims in the township of Teck, adjoining the Tough-Oakes on the west: Nos. L 2100, 2101, 2256 and 2257.

A plant was installed in 1916 and mining operations resumed in April, 1917. Operations were suspended on the first of June, 1917, and since that date no work has been done. The plant consists of a 440-cu. ft. Ingersoll-Rand compressor, one 6 by 8 Jenckes hoist, one 75-h.p. motor and one 60-h.p. boiler.

A shaft was sunk to a depth of 120 feet, and 169 feet of cross-cutting and drifting done on the 100-foot level.

The officers of the company are: President, Harry Oakes; vice-president, Ralph Robbins, Timmins; secretary-treasurer, M. Green, 85 Bay Street, Toronto.

Work was in charge of J. W. Morrison, manager of the Lake Shore mine.

Teck-Hughes.—Development for the year ending August 31st, 1917, by the Teck-Hughes Gold Mines, Limited, was as follows:—

Shaft-sinking	200	feet.
Cross-cutting	775	"
Drifting	1,029	"
Winze-sinking	92	"
Stoping	2,495	"
Side-slicing	3,477	"

The mill treated 6,291 tons of an average value of $7.70, from March 24th, 1917, after the delivery of electric power, to September 1st, 1917. Proposed work

includes a supplementary steam plant for pumping and hoisting, steel shaft house and ore bins, addition to milling plant, and the erection of a number of dwellings for employees.

The main shaft is 400 feet deep, and a winze has been sunk to the 600-foot level.

The officers and directors of the company are: President, Chas. L. Denison, New York; vice-president, Robt. W. Pomeroy, Buffalo; secretary, A. D. Crooks, Toronto; treasurer, H. C. Clarke; Albert W. Johnston and J. F. Thompson, New York.

In February, 1918, L. W. Ledyard was succeeded as resident superintendent by Robert E. Dye, of Cobalt. Eighty men were employed.

Tough-Oakes.—The Tough-Oakes Gold Mines, Limited, has an authorized capital of 600,000 shares, par value $5 each, and is the pioneer producer of the Kirkland Lake camp.

During the year ending December 31st, 1917, underground development was as follows:—

Drifting	2,398.5 feet
Cross-cutting	1,500 "
Raising	496 "
Sinking	105 "
Total	4,499.5 "

Ore stoped amounted to 31,692 tons, and in addition 5,310 tons were produced from development.

During November, 1917, Charles A. O'Connell resigned as manager, and was succeeded by D. H. Angus, of Cobalt. C. E. Rodgers, formerly of the Trethewey mine, is resident manager.

Temiskaming Kirkland.—Prospecting of the Hohenaur claim in Teck township was started in November, 1917, by the Temiskaming Kirkland Gold Mines, Limited. The plant owned by the Temiskaming Mining Company, Limited, at the North Dome mine in Porcupine, was shipped to Kirkland Lake, and before operations were closed in February, 1918, the vertical two-compartment shaft had been sunk to a depth of 40 feet. The plant included one Sullivan compressor, capacity 420 feet, one 80-h.p. return tubular boiler, one 40-h.p. locomotive type boiler, one 8 by 10 Lidgerwood hoist, one 5 by 7 Jenckes hoist, and one 120-volt, Allis-Chalmers generator for lighting purposes.

Work was in charge of William Cooper, of the Temiskaming Mining Company.

Wright-Hargreaves.—The Wright-Hargreaves Mines, Limited, employed an average of 35 men during the year on development work. No. 2 shaft was sunk from the 100-foot level to 320 feet, and No. 3 shaft, which at last report was 100 feet deep, was sunk to the 300-foot level.

A new Ingersoll-Rand compressor, capacity 1,165 cubic feet, was installed during the year.

The officers are: President, Oliver Cabana, Jr.; vice-president, Edwin Lang Miller; secretary-treasurer, Gerhard F. Miller; manager, Albert Wende.

United Kirkland.—United Kirkland Gold Mines, Limited, was organized in the summer of 1917 to develop the Ellis and Dodge claims in the township of Teck. A vertical shaft was sunk to a depth of 90 feet by the contractor, James Harkness, and 23 feet of cross-cutting done at the 90-foot level. Camps were erected and considerable surface trenching and prospecting performed to determine the strike and character of the vein system. Operations were suspended in December, 1917, shortly after the completion of the shaft contract.

The head office of the company is at Haileybury. H. A. Day is secretary-treasurer, and the directors are: W. G. Ellis, Swastika; H. A. Day, Haileybury; Levi Dodge, Englehart; Edward Kert, Smooth Rock Falls.

Associated Goldfields.—The Associated Goldfields Mining Company, Limited, formerly Goldfields, Limited, operated continuously throughout the year 1917. The head office is at 12 King Street East, Toronto, and the officers are: Managing director, George A. MacKay; secretary-treasurer, Howard Webb; mine superintendent, Frederick MacCoy.

In 1914 the claims of the Reddick Gold Mining Company, Limited, were purchased. These claims lie about nine miles northeast of the Goldfields mine. Very little development has been done on the Harris-Maxwell claims. A shaft, inclined at 30 degrees from the horizontal, has been sunk to a depth of 85 feet. From this point the shaft is vertical, and when visited in October, 1917, had been sunk to a depth of 360 feet below the tunnel level, or 425 feet from the surface.

Electric power developed at Raven Falls, 13 miles from the mine, is supplied on a 3-wire (three-phase) system, 13,200 volts, transformed at the mine to 550 volts.

The mill equipment at the Harris-Maxwell mine includes 30 Jenckes stamps and three jaw crushers. The Reddick mine shaft is 90 feet deep, and it was the intention of the management to develop this property during 1918. The plant was repaired and a new compressor, 2,000 cubic feet capacity, installed during the winter.

Porcupine

Ankerite.—The Ankerite Gold Mines, Limited, continued active development of their claims in Deloro township. Originally three claims, ME 60, 61 and 62, were being developed, but during the year the company acquired the Maidens-Macdonald property, under option to the La Rose Company till March, 1917, and also an additional claim south of the Maidens-Macdonald. When visited on January 31st, 1918, a vertical, 3-compartment shaft had been sunk to a depth of 230 feet, and 68 feet of cross-cutting done at the 200-foot level.

The sinking contract was let to the E. J. Longyear Company.

The Ankerite Gold Mines property is owned by the Coniagas Mines, Limited, of Cobalt.

Clifford E. C. Smith is manager of the company.

Davidson.—The Davidson Gold Mines, Limited, continued during the year development of their property near South Porcupine, on lot 2, in the fifth concession of Tisdale township. The main shaft is 312 feet deep with three working

levels. The mine was closed from June, 1917, till January 18th, 1918, and during this interval 500 feet of diamond-drilling was done, chiefly on the first and third levels. A ten-stamp mill was purchased from the Eureka mine, Wine Harbour, Nova Scotia, and erected near the main shaft. Early in 1918 the mill was put in operation. Recovery is made by straight amalgamation.

From May 1st to August 20th, 1917, C. E. Rodgers was manager, and during the balance of the year F. D. Henderson had charge of operations.

Dome.—The Dome Mines Company, Limited, has an authorized capitalization of $5,000,000, of which $4,000,000 has been issued.

The officers of the company are: J. R. DeLamar, president and treasurer; W. S. Edwards, first vice-president; C. D. Kaeding, second vice-president; H. P. DePencier, third vice-president; Alex. Fasken, secretary; Alfred H. Curtis, assistant-secretary and assistant-treasurer. The directors are: J. R. DeLamar, W. S. Edwards, Alex. Fasken, G. C. Miller, J. S. Wilson, A. H. Curtis, Andrew V. Stout, J. S. Bache. The head office of the company is at 36 Toronto Street, Toronto. C. D. Kaeding is general manager.

One dividend, amounting to $100,000, was paid in June, 1917.

The seventh annual report of the company, covering operations for the fiscal year ending March 31st, 1918, divides the year into two periods, one of eight months during which the mill was kept running, and four months when the mill was shut down and development work only was carried on. During the year a total of 258,917 tons was mined and hoisted: of this, 247,000 tons was ore which was sent to the mill and treated, and 11,917 tons was waste which was dumped on the surface. In addition to the above 101,352 tons was mined and remained in shrinkage stopes. The 247,000 tons of ore treated in the mill yielded bullion worth $1,030,758.30, the average yield per ton being $4.173.

On December 1st, 1917, operations in the mill and mine were discontinued, and the main shaft equipped for sinking. On May 20th, 1918, the shaft had reached a depth of 1,200 feet, sinking from the 850-foot level. A large ore and waste pocket and loading station were cut at the 960-foot levels, and stations established at the 1,000 and 1,150-foot levels. Ore reserves as at March 31st, 1918, are estimated at 1,950,000 tons at $5.10, or $9,945,000.

A summary of the development done during the year ending March 31st, 1918, is as follows:—

Level	Drifts	Cross-cuts	Raises	Box Holes	Shafts	Stations	Pockets	Total	Diamond Drilling	Total
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
1st	.....	136.5	.....	.....	.....	.....	.....	136.5	.....	136.5
3rd	253.0	.....	.....	21.0	.....	.....	.....	274.0	1,390.5	1,664.5
4th	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5th	178.5	12.0	111.0	93.5	.....	.....	.....	390.0	1,416.0	1,806.0
6th	262.5	254.0	206.5	103.5	.....	.....	.....	826.5	967.0	1,793.5
7th	532.5	883.5	218.5	346.0	.....	.....	.....	1,980.5	1,710.5	3,691.0
8th	1,370.5	663.0	61.0	.....	.....	.....	66.0	2,160.5	1,848.5	4,009.0
9th	.....	.....	.....	.....	.....	22.0	.....	22.0	.....	22.0
Shaft	.....	.....	.....	.....	178.0	.....	.....	178.0	.....	178.0
Totals	2,592.0	1,949.0	497.0	564.0	178.0	22.0	66.0	5,968.0	7,332.5	13,300.5

During the early part of the year, work was carried on in the Dome Extension, the No. 609 drift being carried ahead a total distance of 29.5 ft. to a point 240.5 ft. across the dividing line of the two properties, where 17.5 ft. of cross-cutting and 26 ft. of raising was done to make a drill station. A total of 1,755 ft. of diamond-drilling was done from underground, mostly toward the ore located south of the porphyry mentioned in the sixth annual report of the company. Four holes totalling 975.5 feet were drilled on the hill to the north of the Dome Extension shaft, but no indication of ore or payable zones was obtained from this work.

Dome Lake.—The Dome Lake Mining and Milling Company, Limited, operated their mine and mill continuously during 1917. Underground development was as follows:—

Drifting	927 feet.
Cross-cutting	304 "
Raising	45 "
Winzing	184 "
Diamond-drilling	3,904 "

The mill treated 16,388 tons during the year, having a gold value of $68,213.99 from which was recovered in bullion $45,029.56, representing an extraction of 66 per cent.

The cost of milling was $1.857 per ton and of mining exploration and development $4.957 per ton.

The 66 per cent. extraction was made by plate amalgamation only.

The officers are: President, George Taylor; vice-president, A. A. McKelvie; directors, T. McCamus, C. L. Sherrill, S. S. Ritchie, F. L. Bapst, S. J. Dark; secretary-treasurer, F. L. Hutchinson; consulting engineer, Douglas A. Mutch; manager, R. T. Regnell.

Hayden.—The Hayden mine, in Ogden township, operated by the Hayden Gold Mines, Limited, was closed most of the year. A vertical two-compartment shaft has been sunk to a depth of 375 feet, with working levels at the 100, 200, and 300-foot levels. The mine closed in May, 1917, and work after that date was confined to diamond-drilling.

W. H. Hayden, 101 North Street, Batavia, N.Y., is president of the company, and W. D. Spaulding, 509 Brisbon Building, Buffalo, N.Y., is secretary-treasurer. William Shovel was mine manager.

Hollinger Consolidated.—Hollinger Consolidated Gold Mines, Limited, has an authorized capital of $25,000,000, divided into 5,000,000 shares of par value $5 each. Outstanding shares January 1st, 1918, amounted to 4,920,000.

The officers are: President, Noah A. Timmins, Montreal; secretary-treasurer, David A. Dunlap, Toronto; managing director, P. A. Robbins; directors, Noah A. Timmins, L. H. Timmins, David A. Dunlap, John B. Holden, P. A. Robbins, and Jules R. Timmins. John McMartin, Cornwall, formerly vice-president and one of the founders of the company, died in April, 1918.

The following statistics regarding the operations for the year 1917 are taken from the company's seventh annual report:—

During the year 508,139 tons of ore were milled, yielding $1,261,938.72; $738,000 was paid in dividends. $1,202,854.97 was paid out for labour and $1,003,332.57 for stores. Total costs, including mining, milling and general charges, amounted to $4.439 per ton of ore milled. The average value per ton of ore milled was $8.67. Mine development amounted to 29,696 feet, as follows: —

Levels	Shafts	Drifts	Cross-cuts	Raises	Diamond Drilling	Timbering	
						Shafts and Winzes	Stopes
	ft.	ft.	ft.	ft.	ft.	ft.	ft.
100	.....	.....	.....	.....	192	129	.....	521
200	.....	.....	2,929	2,778	342	3,200	.....	2,177
300	.....	.....	2,146	1,093	828	1,288	.....	1,660
425	.....	125	2,908	3,927	1,152	1,414	175	3,043
550	.....	232	1,716	829	233	947	233	1,282
675	.....	221	1,555	986	345	1,022	218	120
800	.....	66	1,451	2,489	265	24	185	30
950	.....	.....	33	42	.....	.....	.....	6
1,100	.....	.....	112	184	.....	.....	.....	.....
1,250	.....	.....	124	393	.....	.....	.....	.....
Totals....		644	12,974	12,721	3,357	8,024	811	8,839

The stoping record for the year is shown in the following table:—

Levels	Broken ore in stopes Jan. 1st, 1917	Ore broken during 1917	Ore removed during 1917	Broken ore in stopes Dec. 31, 1917
	Tons	Tons	Tons	Tons
100	4,291	.....	3,026	1,265
200	72,292	105,479	84,047	94,354
300	36,663	143,555	157,966	22,252
425	82,713	162,148	129,965	114,896
550	10,590	37,908	24,917	23,581
675	.....	313	313	.....
800	.....	49	49	.....
Totals	207,179	449,452	400,283	256,348

The estimated gross value of ore reserves at December 31st, 1917, amounted to $40,231,435. The average number of men employed during the year was 1,045.

Keora.—The Keora mine is located on lot 6, in the Sixth Concession of the township of Whitney, and is owned by the Porcupine Keora Mining Company, Limited. Development consists of two shafts, one vertical 120 feet deep, and one incline 60 feet deep. Work during 1917 was confined to diamond-drilling, 2,312 feet being completed.

A. J. Brandt, South Porcupine, is general manager, and William B. Gunton, 304 Confederation Life Building, Toronto, secretary-treasurer.

McIntyre.—During the year ending June 30th, 1918, the McIntyre Porcupine Mines, Limited, milled 178,327 tons of ore, with a gold production of $1,717,309.88.

Underground development for the 12 months' period is shown in the following table:—

	Pockets	Stations	Shafts	Sumps	Drifts	Cross-cuts	Raises	Winzes	Total	Diamond Drilling
July 1, 1917 to June 30, 1918	75.0	92.9	423.5	9.6	4,686.1	1,196.5	346.0	63.0	6,892.6	6,987.0
Total prior to July 1, 1917	....	997.1	4,786.6	131.7	22,540.0	11,304.8	4,497.4	393.2	44,651.0	19,920.2
Total to date..	75.0	1,090.0	5,210.1	141.3	27,226.1	12,501.3	4,843.4	456.2	51,543.6	26,907.2

The Jupiter shaft was completed to the 1,000-foot level, and the drift on this level to connect the main shaft with the Jupiter was driven 1,300 feet. At this point, about 1,000 feet from the Jupiter shaft, in the quartz-porphyry formation, heavy water was encountered and the drift was abandoned until an adequate pumping plant could be installed.

From the Jupiter shaft at the 475-foot and 1,000-foot levels, cross-cuts have been driven into the Plenaurum ground. In July, 1918, the cross-cut at the 1,000-foot level had been driven 250 feet in Plenaurum ground, and it was the intention of the management to diamond-drill from both the 475 and 1,000-foot levels. Two new electrically driven hoists were installed during the year. At No. 5 shaft, a Nordberg was ready for operation in July, 1918, and the headframe raised ten feet to permit of greater clearance and allow for installation of an 84-inch sheave. At the Jupiter shaft a large Welster, Camp and Lane hoist has been installed.

In the mill a duplicate clarification system has been added to the equipment.

A modern dry house to accommodate 250 men has been built at No. 5 shaft, and electric haulage installed on the 1,000-foot level.

The officers of the company are: President, J. P. Bickell; vice-president, Sir Henry M. Pellatt; secretary-treasurer, M. P. Van der Voort, all of Toronto; directors, W. J. Sheppard, Waubaushene, J. B. Tudhope, Orillia; E. F. B. Johnston, Toronto; H. D. Symmes, Niagara Falls; general manager, R. J. Ennis; mine superintendent, J. E. McAllister; mill superintendent, A. Dorfman.

An average of 332 men was employed during the year.

Newray.—The Newray Mines, Limited, operating the Rea property in Tisdale township continued development work chiefly on the 400-foot level, till November 1st, 1917. During this period the cross-cut on the 400-foot level was driven 1,150 feet in a southeasterly direction. The property was then optioned to the Porcupine Crown Mines, Limited, and work was continued by them until February 1st, 1918. The Porcupine Crown Company did about 700 feet of diamond-drilling and 600 feet of drifting, and abandoned their option.

On May 1st, 1918, the McIntyre Porcupine Mines, Limited, acquired an option and began sampling operations. Due to labour conditions, underground work was stopped on June 20th, 1918. The mill was operated for three months during the year by the Newray Mines Company, and from June 24th, 1918, to July 20th, 1918, by the McIntyre Company.

The officers of the Newray company are: President, Dr. Bixby, Buffalo, N.Y.; vice-president, Henry Tudor, New York; secretary-treasurer, J. E. Day, Toronto; managing director, C. P. Charlebois.

Night Hawk.—About eight miles south of Connaught station, on the Porcupine branch of the T. & N.O. railway, in the township of Cody, the Porcupine Night Hawk Mining Company, Limited, continued the development and prospecting of their claims on Night Hawk lake. A vertical shaft has been sunk to a depth of 90 feet, and 380 feet of cross-cutting and drifting done at the bottom level. During the year 500 feet of diamond-drilling was completed. The plant includes one compressor, capacity 300 cubic feet, one Jenckes 5 by 7 hoist, 2 locomotive boilers, 60 and 80-h.p.; blacksmith shop and camps. Work was carried on continuously during 1917 till October 1st, when operations were suspended because of high operating costs and shortage of labour.

The officers are: President, O. B. Wilcox, New York; treasurer, J. H. Black, Toronto; directors, Charles Auer, Timmins, and F. D. Forbush, Detroit. William Watson was mine manager.

North Davidson.—The North Davidson Gold Mines, Limited, did 1,500 feet of diamond-drilling on their property on lot 3, in the sixth concession of Tisdale township.

A wagon road was also partly completed between the Davidson mine and the North Davidson claim.

The officers are: President, R. T. Jeffrey; managing director, L. G. Harris, Royal Bank Building, Toronto.

F. D. Henderson was in charge of operations at the property, and the company planned to sink a 300-foot shaft during the summer of 1918.

McEnaney.—McEnaney Gold Mines, Limited, operated at intervals during the year. The property was formerly known as the Hollinger Reserve, and is located on lots 2 and 3, in the fifth concession of Ogden township. Development during 1917 included 250 feet of drifting and cross-cutting on the 100-foot level, sinking winze east of the shaft from 300-foot level to 410-foot level, and raising from the 200 to 100-foot level. The mine was de-watered in January, 1917, and operations were suspended in September, 1917. Work was resumed on November 1st and again closed on February 12th, 1918.

The late Bernard McEnaney was president of the company and principal owner of the property. William Sixt was mine manager.

Porcupine V.N.T.—During 1917, underground operations by the Porcupine V.N.T. Gold Mines, Limited, were confined to the North Thompson section, from which 27,805 tons of ore were mined. No ore was produced from the Vipond section, operations there being postponed until the connection has been completed

between the North Thompson and Vipond shafts at the 600-foot level, when the underground operations will be centralized at one shaft. The mill on the Vipond property was run continuously, producing 19,360.27 ounces of bullion, worth $205,914.29. A new electrically driven Ingersoll-Rand compressor, capacity 7,050 cubic feet, was installed. A new transformer station was built on the North Thompson section of the property of sufficient capacity for all the power that will be required in the future. During the early part of the year operations were greatly hindered by the uncertain labour conditions.

The company has an authorized capital of 3,000,000 shares of par value $1.00.

The officers are: President, H. H. Ward, New York; vice-presidents, F. H. Hamilton and P. W. Furber, London, England; secretary-treasurer, R. J. Ward, New York; directors, R. T. Shillington, Haileybury; James J. Hill, St. Paul; D. J. Jackson, New York; Henry Pellatt, Toronto. N. J. Evered, Box 189, Timmins, is general manager, and the head office of the company is 50, East 42nd Street, New York.

Porcupine-Crown.—Porcupine-Crown Mines, Limited, has an authorized capital of 2,000,000 shares of $1 par value each. The officers are: President, John W. Carson; first vice-president, William I. Gear; 2nd vice-president, James G. Ross; secretary-treasurer, James Cooper, all of Montreal. The directors include the above officers and C. A. Smart, J. W. Ross, A. G. Gardner, F. S. Meighen, Ziba Gallagher, and R. W. Reford. S. W. Cohen is general manager and Maurice W. Summerhayes, manager.

During 1917, 32,732 tons of ore were milled of an average value of $10.97. The net value of the production after deducting charges was $363,793.34.

The underground development during the year was practically all done below the 500-foot level. Ore reserves at the close of the year were estimated to be about 60,000 tons.

No dividends were paid after July 1st, owing to curtailment of production. For the first half of the year dividends amounting to $120,000 were paid, bringing the total amount paid in dividends to date $840,000.

Premier.—Porcupine Premier Gold Mines, Limited, operated their mine on lot 6, in the sixth concession of Deloro township, for the first half of the year only.

No. 1 shaft was completed to the 200-foot level, and a cross-cut driven to the south 170 feet, at which point a promising vein was encountered. No. 2 shaft was raised from the 100-foot level to the 60-foot, giving an auxiliary exit from the 100-foot level to the surface.

The officers are: President, George W. Field; secretary, Frank J. Wright, both of 19, Congress Street, Boston, Mass.; general manager, A. S. Fuller, South Porcupine. B. M. Walton is mine superintendent.

Rypan.—The Rypan Porcupine Mines, Limited, began work on their four claims in Deloro township on May 15th, 1917. Prospecting by surface trenching and open-cuts on the outcrops continued till August 23rd, 1917, when operations were suspended.

The officers are: President, John Patterson, Toronto: secretary, J. W. Ryder, Toronto. C. L. Heath was in charge of the development.

Schumacher.—The Schumacher Gold Mines, Limited, has an authorized capital of 2,000,000 shares of par value $1 each.

The officers are: President, F. W. Schumacher; vice-president, F. L. Culver; secretary-treasurer, J. Y. Murdoch: manager, T. J. Harwood.

For the year ending March 31st, 1918, the following development was performed:—

Drifting	1,420 feet.
Cross-cutting	1,096 "
Raising	178 "
Diamond-drilling	705 "
Stoping	36,446 tons.

Shortage of labour resulted in the mine and mill being closed from June 26th to August 20th, 1917. During the remaining ten months of the year the mill treated 39,822 tons of ore, with a production of bullion valued at $202,387.35. Extensive additions and improvements were made in the mill, involving an expenditure of $39,554.90; additions to mining plant cost $13,090.59.

Stanley A. Wookey resigned as manager to enlist with the Canadian Engineers, and was succeeded by T. J. Harwood, formerly of La Rose mine.

West Dome.—West Dome Consolidated Mines, Limited, worked continuously throughout the year. Total development at the several shafts to March 15th, 1918, was as follows:—

No. 1 or main shaft, 358 feet deep on incline;
100-foot level, cross-cutting 645 feet;
300-foot level, cross-cutting 1,457 feet, drifting 2,352 feet.
No. 3 shaft, 115 feet deep, vertical; cross-cutting 300 feet; drifting 180 feet.
No. 4 shaft, 98 feet deep, vertical; drifting 15 feet;
No. 2 shaft, 30 feet deep, vertical;
Central shaft, 35 feet deep, vertical.

During 1917, work was practically confined to development at the 300-foot level of the main shaft, and the sinking of the new central shaft to a depth of 35 feet. In the spring of 1918 stoping was commenced on the 300-foot level, main shaft, and about 600 tons were broken. Of this amount 300 tons were hauled to the Dome Lake mill, during the month of May, 1918, and a test mill-run made.

The officers are: President, Henry Pellatt; secretary-treasurer, C. H. Manaton, Traders' Bank Building, Toronto; consulting engineer, Frank G. Stevens, Toronto. The manager, W. J. Trethewey, was succeeded in February, 1918, by Frank Hamilton, formerly mine captain.

Thirty-five men were employed during the year.

Whelpdale.—The Whelpdale mine is situated near Timmins, and comprises the Whelpdale veteran claim of 160 acres, being the north half of lot 11, in the third concession of Tisdale township. Development in the early stages was carried on by the Porcupine Whelpdale Mining Syndicate. Late in 1917 the Porcupine Whelpdale Mines, Limited, was organized, with the following officers: President, J. A. Kilpatrick, Toronto: vice-president, Frank P. Jones, Montreal: secretary-treasurer, B. J. Simons, Toronto: directors, George Tamblyn, R. M. Gray, J. O.

Gadsby, S. B. Dawson, C. M. Dineen, R. L. Marks, all of Toronto. The head office address is 910 and 911 Royal Bank Building, Toronto, and H. Max Guenther, Box 391, Timmins, is manager. When inspected on February 13th, 1918, a vertical shaft had been sunk to a depth of 114 feet, with a station at the 100-foot level. About 30 feet of cross-cutting had been driven at this level.

Miscellaneous Mines

Alexo Nickel.—During 1917, the Alexo Mining Company, Limited, shipped 6,003.3 tons of nickel ore to the Coniston smelter of the Mond Nickel Company. The company own five claims in the townships of Clergue and Dundonald, the chief development being in the N.E. quarter of S. half of lot 1, concession III., township of Clergue, about two miles from Porquis Junction, on the Timmins branch of the T. & N. O. railway.

The officers of the company are: President, G. F. Hanning, Toronto; vice-president, Major E. F. Pullen, France; treasurer, H. N. Roberts; director, Capt. F. Pullen; manager, William Anderson.

During 1917 the main shaft was sunk from the 125-foot level to a depth of 326 feet, and about 70 feet of drifting done at the bottom level. All the production came from the 125-foot level.

The plant consists of one locomotive type 60-h.p. boiler, one upright 30-h.p. boiler, one Canadian Westinghouse compressor, and one 6 by 8 Jenckes hoist.

The decreased production during the year was due to car shortage.

Premier Langmuir Barite.—The Premier Langmuir Mines, Limited, own seven patented claims in the township of Langmuir, on the east branch of the Night Hawk river. By water route the property is 30 miles from Connaught station, on the T. & N. O. railway.

The geology of this deposit has been fully described in previous reports of the Bureau of Mines, and it is the only mine in the Province producing barite on a commercial scale. A vein of barite, varying from 5 to 10 feet in width, has been traced for a distance of 1,000 feet on the property. A tunnel, driven on the vein for a distance of 100 feet, shows native silver in several places. When inspected on February 1st, 1918, a shaft had been sunk at the portal of the tunnel to a depth of 55 feet, and it was the intention of the management to sink to the 120-foot level and develop the ore body there.

The officers are: President, J. A. McIntosh, 454 Markham Street, Toronto; secretary-treasurer, J. B. Aikenhead, London, Ontario; mine manager, Charles W. Dalby.

An average of 17 men was employed during the year.

Colorado Ontario.—In the spring of 1918, the Colorado Ontario Development Company began active exploration and development of the Otisse and Robb gold claims in Powell township. A wagon road was built from Elk Lake to the claims, a distance of 30 miles, and supplies were taken in for the summer. Diamond-drilling started May 21st, 1918.

Walter J. Boland, No. 2 Toronto Street, Toronto, is secretary-treasurer of the company, and T. J. Flynn, superintendent.

Cobalt Silver Mines

Adanac.—The Adanac Silver Mines, Limited, worked continuously throughout the year on their property in southeast Coleman, formerly known as Pan Silver.

Work was practically confined to the 310-foot level, cross-cutting north to encounter veins discovered by diamond-drilling. In April, 1918, the cross-cut heading was 500 feet from the shaft. Developments proved satisfactory to the owners and will be continued during 1918.

The officers are: President, R. A. Cartwright; vice-president, E. N. Campbell; treasurer and managing director, Morgan B. Cartwright, Haileybury; secretary, James Aitchison, Toronto; directors, R. A. Cartwright, E. N. Campbell, Morgan B. Cartwright, J. L. Wheeler, Marion, South Carolina, and A. B. Hind.

Aladdin.—The Aladdin Cobalt Company, Limited, operated continuously throughout the year. Work was confined to No. 4 shaft of the Chambers-Ferland, west of the railway, and the discovery of several promising ore shoots materially added to the production.

Development during the year was as follows:—

Drifting and cross-cutting	2,323	feet.
Sinking	113	"
Stoping	3,970	cubic yards.

The greatest production came from stoping operations, on an extension of No. 15 vein, 275-foot level.

The ore was milled at the Northern Customs concentrator.

The officers are: President, Major Conrad Jorgenson; secretary-treasurer, F. F. Fuller; directors, Major Charles Gold, Dennis Herbert, H. B. Sedgwick, all of London, England; Canadian advisory board, Charles A. Richardson, Arthur Ferland, and R. T. Shillington, all of Haileybury; Alex Fasken, Toronto, secretary.

Head office for Canada, Excelsior Life Building, Toronto. J. A. McVichie, Cobalt, is manager of the company.

Beaver.—Beaver Consolidated Mines, Limited, has an authorized capital of 2,000,000 shares, of par value $1 each. The officers are: F. L. Culver, President and general manager; F. C. Finkenstaedt, vice-president; H. E. Tremain, secretary-treasurer. The directors are: F. L. Culver, F. C. Finkenstaedt, F. L. Lovelace, Wm. T. Mason, Wm. E. Stevenson, H. E. Tremain, J. H. Black. Head office, Lumsden Building, Toronto. The following is a synopsis of development during the year ending February 28th, 1918:—

Drifting	2,245.1	feet.
Cross-cutting	1,453.3	"
Sinking	75.1	"
Raising	1,178.4	"
Total	4,951.9	"
Stoping	4,187.7	cubic yards.

Most of the work during the year was done on No. 2 and No. 3 vein systems. The annual report of the company states that in No. 2 vein system a body of ore has been opened up which has greatly augmented the ore reserves of the mine. Regarding development on the 1,600-foot level, the annual report states as follows:—

"Milling values have been proven for a distance of 67 feet below the 1,600-foot level by sinking a winze on the vein. Anticipating that the highest values would be found at or near the contact between the diabase and Keewatin formations, the vein was followed up by a raise for 147 feet above the 1,600-foot level and milling values established for this distance. However, not having reached the contact on account of the dip of the sill, and the expense of raising beyond this point, together with the danger attached thereto being very great, work was discontinued in this raise and a cross-cut is being driven from the main shaft on the 1,400-foot level to intercept the vein in hopes of locating the contact at or about this point."

The total production for the year amounted to 372,973 ounces of silver.

The Beaver Auxiliary property was not worked during the year.

Buffalo.—The Buffalo Mines, Limited, operated continuously during the year. Underground operations were as follows:—

—	Raising	Drifting	Stoping
	ft.	ft.	cubic ft.
1st Level	.....	265	200,500
2nd "	295	375	251,700
3rd "	20	140	.....
Total	315	780	452,200

The tonnage broken in raising was 1,312 tons, in drifting 2,275 tons, and in stoping 37,683 tons. Total tonnage broken 41,270, less waste rock 800 tons. Net ore tonnage, 40,470 tons.

The above figures are for the fiscal year ending April 30th, 1918. For the eleven-month period ending March 31st, 1918, there were recovered in jig and table concentrates, 280,790 ounces of silver, and in flotation concentrates from the treatment of 82,328 tons of sand, 356,361 ounces of silver, making a total of 637,151 ounces. The Holt-Dern furnace installation for the treatment of flotation concentrates was abandoned early in the year, and the concentrates were thereafter shipped to Denver.

The officers are: President, Charles L. Denison, New York; vice-president, Robt. W. Pomeroy, Buffalo, N.Y.; 2nd vice-president, Harland B. Crandall, New York; secretary-treasurer, George C. Miller, Buffalo; director, Albert W. Johnston, New York. Tom R. Jones, Cobalt, is general superintendent.

Casey-Cobalt.—The Casey-Cobalt Silver Mining Company, Limited, continued active development of their mine in Casey township throughout the year. Until March 5th, 1917, work was confined to de-watering and repairing No. 6 shaft, and reconstructing the surface plant destroyed in the fire of August 22nd, 1916. The following progress was made underground:—

Stoping	10,932 cubic feet.
Development	774 lineal feet.
Exploration	1,723 " "

A concentrating mill was built during the winter of 1917-18 and put in operation in March, 1918.

The average number of men employed from March, 1917, to the close of the year was 59.

The officers are: President, W. R. P. Parker; vice-president, J. P. Watson; secretary, W. W. Perry, all of Toronto. Head office, 1,514 Traders' Bank Building, Toronto; manager, John W. Shaw, New Liskeard.

Casey Mountain.—The syndicate operating the Casey Mountain Mining Company, Limited, on lot 6, in the second concession of the township of Casey, continued development during the greater part of 1917. A cross-cut on the 345-foot level was driven about 90 feet, when operations were suspended to permit of diamond-drilling underground.

The officers of the operating syndicate are: President, J. D. Martin, Regina; vice-president, H. M. Richardson, Fort Qu'Appelle; secretary-treasurer, A. J. Cameron, Regina; directors, Geo. Speers, Regina; A. Cunningham, Moose Jaw; manager, R. G. Williamson, Judge P.O., Ontario.

The Toronto office is 115 Stair Building, Toronto, and Wm. A. Staples is secretary-treasurer; R. G. Williamson, president, and James Thompson, Havelock, vice-president.

Coniagas.—The Coniagas Mines, Limited, has an authorized capital of 800,000 shares of par value $5 each. The officers are: President and general manager, R. W. Leonard; vice-president, Alex. Longwell; secretary-treasurer, J. J. Mackan; superintendent, Fraser D. Reid. Included with the above officers on the board of directors are: R. P. Rogers, F. J. Bishop, R. L. Peek, and W. D. Woodruff. Head office is at St. Catharines, Ontario.

The total distribution in dividends to the shareholders to date aggregates $8,740,000.

For the year ending October 31st, 1917, underground development was confined to the following of small veins and stringers on all levels, exploring the contact on the eastern boundary and driving numerous cross-cuts through unexplored areas. This work disclosed some patches of high-grade and a considerable tonnage of low-grade milling ore. The further discovery of ore shoots of any importance is considered unlikely, as practically all the mine has been prospected.

Statistics of mine development are:—

	Total to Oct. 31, 1917	Total to Oct. 31, 1916	Work during 1916-17
	ft.	ft.	ft.
Shaft-sinking	879	875	4
Drifting	18,834	17,611	1,223
Cross-cutting	10,295	9,527	768
Winzing	632	632	.....
Raising	1,396	1,067	329
Total	32,036	29,712	2,324

Total ounces of silver shipped to Thorold during the year, 1,344,267.43.

The concentrating mill treated 60,929 tons, or an average of 3.07 tons per stamp per 24 hours.

The Callow flotation plant was put in operation February 6, 1917, and has effected a material reduction in the value of the mill tailings. Ore reserves at October 31st, 1917, were estimated to contain 4,487,590 ounces of silver.

An average of 110 men was employed during the year.

Crown Reserve.—The Crown Reserve Mining Company, Limited, has an authorized capital of 2,000,000 shares, of a par value of $1 each. The officers and directors are the same as for the Porcupine Crown Mines, Limited. S. W. Cohen is general manager and J. H. Stewart, mine superintendent.

During the year 1917 the production amounted to 329,670 ounces, making the total production of the mine 19,690,676 ounces.

Underground development was as follows:—

Sinking and raising	354 feet.
Drifting	1,849 "
Cross-cutting	595 "

At the Cochrane mine 938 feet of development was driven at the 550-foot level, practically all on the vein. Good ore was encountered in several places in this development, and some spots of high-grade were found. The work demonstrated that the probabilities of opening up ore of commercial value were limited, and work was discontinued.

The Drummond Fraction was operated only part of the year, owing to severe weather and shortage of labour.

About 100 feet of development was done on the Silver Leaf lease, at the 300-foot level on the extension of the north vein of the Crown Reserve mine. Milling ore of fair grade was opened up.

Dickson Creek.—The Dickson Creek Mining Company, Limited, operated the first two months of the year on their property, lots 9 and 10 in the fifth concession of Bucke township. Work was confined to shaft-sinking. In March, 1918, operations were resumed, and on May 21st, 1918, the shaft had been sunk to a depth of 160 feet.

The company is composed of London, England, capitalists. H. Holland-Hurst, Haileybury, is manager.

Dominion.—The Dominion Reduction Company continued to operate the Dominion mine, formerly known as the Nova Scotia. Work—wall-slashing for mill rock—was confined chiefly to the main or Bilsky vein. At No. 3 shaft, 150 feet of drifting was done at the 75-foot level.

Fifteen men were employed during the year.

Dominion Reduction.—The 10-stamp custom mill operated by the Dominion Reduction Company worked continuously throughout the year. Ore, treated as in previous years, was supplied chiefly by the Kerr Lake and Crown Reserve mines, with small tonnages from the Chambers-Fe land and Hargr ve For the fiscal year ending September 30th, 1917, 56,558 tons of ore were milled having an

average silver content per ton of 24.24 ounces, total silver produced being 1,370,861 ounces.

The Holt-Dern equipment for treating flotation concentrates was increased to four furnaces. The roasted concentrates are leached with an acid brine solution and the silver precipitated on copper.

The officers are: President, D. M. Steindler, New York; vice-president, Mortimer B. Davis, Montreal; secretary and general manager, Eugene L. Steindler, Cobalt; assistant manager, P. L. Blodgett, Cobalt; mine superintendent, H. R. Bischoff, Cobalt.

Edwards and Wright.—Messrs. Edwards and Wright, Toronto, acquired the Green-Meehan and Red Rock properties by purchase, and during the summer of 1917 the shafts were de-watered and the workings thoroughly sampled.

At the Green-Meehan the shaft is 200 feet deep and has been further developed by a winze 45 feet deep. In April, 1918, a promising vein was encountered on the 245-foot winze level.

The dump at the Green-Meehan shaft is being milled at the Northern Customs concentrator, and drifting on the new vein is in progress towards the Red Rock workings.

John Edwards is in charge of operations with E. J. McMillan as mine captain. Twenty-five men are employed.

Genesee.—The Genesee Mining Company, Limited, worked continuously throughout the year, on their lease from the United States Cobalt Mining Company, of the southwest quarter of the south half of lot 9, concession 1, township of Bucke. At the close of the year the shaft had been sunk to a depth of 572 feet, and stations cut at the 350, 450, 500 and 550-foot levels; about 100 feet of cross-cutting and drifting had been done on the 500-foot level.

The officers are: President, Ralph H. Gorsline, Rochester, N.Y.; secretary-treasurer, Alex. Russell, Rochester, N.Y.; A. A. Amos, Cobalt; manager, Leonard F. Steenman, Cobalt.

Gifford.—The Gifford Cobalt Silver Mining Company resumed operations on their property adjoining the Beaver in August, 1917. The shaft is 200 feet deep, and at the close of the year a winze located 400 feet northeast of the shaft had been sunk to a depth of 150 feet, and 100 feet of cross-cutting done at the bottom level.

Difficulty was experienced in handling the water, and early in 1918 the mine was closed.

Frank B. Mosure of Toronto was manager, and J. Bedford mine captain; employing 12 men.

Hargrave.—The Hargrave Silver Mines, Limited, operated continuously throughout the year. Following is a summary of the underground work done:—

Drifting	421	feet.
Cross-cutting	235	"
Raising	664	"
Sinking	124	"
Total	1,444	"

Ore hoisted amounted to 2,556 tons, yielding 75,202.14 ounces of silver, of a gross value of $52,324.02. Operating expenses amounted to $53,254.64.

The officers are: President, James A. Aitchison; secretary-treasurer, Geo. H. Sedgwick; manager, J. T. Shaw. Head office, Excelsior Life Building, Toronto.

Hudson Bay.—The Hudson Bay Mines, Limited, operated their mine and mill continuously during the year. Underground development was as follows:—

Drifting	655.7 feet.
Cross-cutting	359.7 "
Raising	637 "

This work opened up several small veins; one known as the "Branch vein" was picked up on the first level west of the shaft and stoped on for a length of 140 feet.

During the year the mine produced 261,887.09 ounces at a total cost of production, including selling cost, of 13.57 cents per ounce. The mill treated 18,247 tons of 17.3-ounce ore, and recovered 262,863.7 ounces of silver, equivalent to an extraction of 83.2 per cent. The cost of treatment was $2.09 per ton or 14.5 cents per ounce recovered.

No work was done at No. 2 mine, or on the Gowganda and Kirkland Lake claims owned by the company.

The officers are: President, George Taylor; vice-president, A. A. McKelvie; secretary-treasurer, F. L. Hutchinson; manager, Douglas A. Mutch; directors, S. S. Ritchie, T. McCamus, William H. Kinch, C. L. Sherrill, F. L. Bapst.

Kerr Lake.—The Kerr Lake Mining Company has an authorized capitalization of $3,000,000, divided into 600,000 shares of par value $5 each.

The officers are: President, Adolph Lewisohn, New York; vice-president, Sam A. Lewisohn, New York; secretary-treasurer, E. H. Westlake, New York; mine manager, H. A. Kee, Cobalt.

Underground development for the fiscal year ending August 31st, 1917, was as follows:—

Drifting	1,268 feet.
Cross-cutting	588 "
Raising	1,197 "
Sinking	52 "

Total development, 3,105 feet; total stoping, 34,597 square feet, total side-cutting, 114 square feet.

The gross production from all ores amounted to 2,551,345.94 ounces of silver and 89,453.63 pounds of cobalt. The ore reserves at the close of the year were estimated to contain 3,120,400 ounces of silver.

Production from the Drummond Fraction amounted to 67,112 ounces, taken chiefly from a smaltite vein which is the easterly extension of the Fleming vein, also from a vein which is the westerly extension of the Comet vein. Work on the Drummond was discontinued January 31st, 1917.

The costs of production per ounce were as follows:—

Mining and development	11.65 cents.
Shipment and treatment	14.52 "
Administration and general	00.58 "
Total	26.75

La Rose.—The capital stock of La Rose Mines, Limited, was reduced by letters patent dated November 12th, 1917, from the sum of $6,000,000, divided into 6,000,000 shares of $1.00 each, to the sum of $1,500,000 divided into 1,500,000 shares of $1.00 each. Pursuant to a resolution passed by the stockholders of La Rose Consolidated Mines Company on December 10th, 1917, all the liabilities of the Consolidated Company were assumed by La Rose Mines, Limited, and all the assets of the Consolidated Company except 1,500,000 shares of La Rose Mines stock, are now vested in La Rose Mines, Limited. The Consolidated Company will be dissolved.

The officers are: President, D. Lorne McGibbon; vice-president, Shirley Ogilvie; secretary-treasurer, S. J. LeHuray; general manager, G. C. Bateman. The directors are: D. Lorne McGibbon, Edwin Hanson, E. W. Nesbitt, W. A. Black, Victor E. Mitchell, K.C., Wm. Dobell, Shirley Ogilvie, David Fasken, S. J. LeHuray. Head office, 260 St. James Street, Montreal.

Development work during the year was as follows:—

—	Trenches	Shafts	Drifts	Cross-cuts	Raises	Stopes
	ft.	ft.	ft.	ft.	ft.	cu. yds.
La Rose	88	.....	934.5	304	270	334
Lawson	60	.....	115.5	467.5	42	221
Violet	.....	382.5	.....	.....	.....	.....
	148	382.5	1,050	771.5	312	555

The total silver obtained from all sources was 478,639 ounces, having a gross value of $371,583.84, and produced at a total cost of $300,211.42, the profit on which was $71,372.42. The average price received for silver during the year was 82.94 cents. No work was done on the Princess, Fisher-Eplett, and University mines. A new shaft was sunk on the Violet, which adjoins the O'Brien on the east. The Keewatin-diabase contact was cut at 383 feet, and the shaft continued to the 425-foot level. Cross-cutting encountered veins showing considerable values.

Exploration work was done on two gold properties held under option, but results were not encouraging, and the options were dropped.

McKinley-Darragh-Savage.—During the year 1917, the McKinley-Darragh-Savage Mines of Cobalt, Limited, recovered 908,756 ounces of silver from their mining and milling operations, bringing the total production up to 17,323,102 ounces. The average price received for silver during the year was 83.20 cents per ounce, and the total costs 57.09 cents. The ore reserves on January 1st, 1918, were estimated to contain 1,076,182 ounces.

The tailing mill was not operated, due to non-delivery of grinding machinery. Underground development was as follows:—

Cross-cutting	1,876.5	feet.
Drifting	2,408.0	"
Raising	374.5	"
Shaft-sinking	14.5	"
Winzing	12.0	"
Total	4,685.5	"

The mill treated 68,142 tons of ore, yielding a total recovery of 796,298 ounces.

The officers are: President, J. R. L. Starr, Toronto; vice-president, Thos. W. Finucane, Rochester; treasurer, Harper Sibley, Rochester; secretary, J. H. Spence, Toronto; manager, T. R. Finucane, Cobalt. The head office of the company is at the Trusts and Guarantee Building, Toronto.

Mining Corporation of Canada.—The Mining Corporation of Canada, Limited, own the Cobalt Townsite, Cobalt Lake, City of Cobalt, Townsite Extension and Little Nipissing mines. The Cobalt Reduction Company is also controlled by the Corporation, which is capitalized at 2,075,000 shares of $1 each, all issued. The officers and directors are: Sir Henry M. Pellatt, president; J. P. Watson, first vice-president; W. R. P. Parker, second vice-president; G. M. Clark, J. G. Watson, D'Arcy Weatherbe, Capt. R. E. G. Van Cutsem; D'Arcy Weatherbe, consulting engineer; C. E. Watson, resident manager; M. F. Fairlie, superintendent of reduction works. The head office is at 1512-1520 Traders' Bank Building, Toronto.

The following statistics of operation are taken from the annual report of the Corporation for 1917:—

Production	Hoisted	Broken	Treated
	tons	tons	tons
Townsite	24,900	10,266	43,074
City	37,527	27,097	37,527
Lake	3,484	1,587	3,484
Total	65,911	38,950	84,085

Of the total tonnage hoisted 416.78 tons of high-grade were treated in the high-grade plant of the Cobalt Reduction Company; 179.07 tons of lower grade shipping ore went direct to the smelter, and 83,488 tons were concentrated. From all sources a total of 4,485,542 ounces of silver was produced, as compared with 1,457,440.80 for 1916. The net profits carried forward amounted to $2,557,091.89. Of this amount, $1,556,296.86 was paid in dividends, and $1,000,795.03 was carried to surplus, which at December 31st, 1917, amounted to $3,448,377.68. High-grade ore treated averaged 3,007.06 ounces per ton, and milling ore averaged 36.99 ounces per ton.

DETAILS OF UNDERGROUND WORK IN 1917

——	Drifts	Cross-cutting	Sinking	Raising	Total	Stoping
	ft.	ft.	ft.	ft.	ft.	cu. ft.
Ore extraction	.....	.....	.....	.....	.....	468,091
Development	716	.....	12	121	849	.....
Exploration	785	6,206	327	327	7,645	.....
Total	1,501	6,206	339	448	8,494	468,091

Diamond-drilling amounted to 86 feet.

The total footage of drifts, cross-cuts, raises, winzes and shafts in the workings of the Corporation aggregated 21 miles at the end of 1917.

The Cobalt Lake mill was not operated during the year.

The Cobalt Reduction Company's concentrating mill and cyanide plant ran continuously, excepting holidays, during the year. Stamps dropped 95.47 per cent. and the ball mill ran 97.84 per cent. of possible time. The use of the ball mill was discontinued in January, 1917, tube mills were introduced, and the flow sheet somewhat altered during the autumn of 1917.

Extraction from milling ores and slimes was 92.11 per cent. as against 88.31 per cent. in 1916. The high-grade plant has proved an unqualified success. The direct saving over the previous practice of shipping products to the smelter, has more than paid twice the cost of the plant during the year.

The high-grade plant treated during the year 1,546.68 tons of high-grade material, which produced 3,716,611.63 ounces of silver. During 1918, sands from Cobalt Lake will be pumped to stock piles, classified and treated.

The cost of concentrating and cyaniding was $2.53 per ton treated.

CONCENTRATION AND CYANIDING

	Tons ore concentrated	Tons Concentrates produced	Ounces contained	Tons Slime Cyanided	Ounces Bullion produced by Cyaniding
Townsite and City	80,127.94	1,162.16	2,466,592.21	41,509.31	479,936.34
Lake	3,360.84	58.46	119,301.31	1,730.62	22,643.89
Total	83,488 78	1,220 62	2,585,893.52	43,239 93	502,580 23

The total costs including royalties, head office, etc., per ton of ore treated amounted to $19.26, and 36.11 cents per ounce of silver produced. The average number of men employed was 326.

The total consumption of powder amounted to 180,100 pounds.

Ore reserves at the close of the year were as follows:—

High-grade ore	690,600	ounces.
Milling ore	854,770	"
Total	1,545,370	"

A total of 90 properties in Canada and the United States were examined during the year. In the Cobalt district, the Alexandra and Waldman were optioned in the fall of 1917. Both shafts were de-watered in November, 1917, and development continued until May 1st, 1918, when the Alexandra was abandoned. Work on the Waldman was continued under the direction of Capt. Fancy.

National.—The National Mines, Limited, continued underground development of their mine near Cross Lake, formerly known as the King Edward, up to the end of June, 1917. For the balance of the year, operations were confined to pumping and milling tailings from Cross lake. On December 17th, 1917, the

mill was closed and all operations suspended till April 15th, 1918. On that date milling of King Edward tailings was resumed, and it is the intention of the company to install a second sand-pumping unit, and mill Silver Cliff tailings during the summer of 1918.

The officers are: President, H. E. Jackman; secretary-treasurer, Ernest Whitbeck, both of 17 Ellwood Building, Rochester, N.Y.; manager, C. A. Filteau, Box 749, Cobalt.

Nipissing.—The Nipissing Mining Company (the operating company) has an authorized and issued capital of $250,000, divided into 2,500 shares of par value of $100 each. The officers are: David Fasken, president; E. P. Earle, vice-president; Alexander Fasken, secretary; P. C. Pfeiffer, treasurer. The directors are: W. H. Brouse, David Fasken, E. P. Earle, Richard T. Greene, R. B. Watson is general manager; Charles Butters, consulting metallurgical engineer; Hugh Park, manager; James Johnston, mill manager; James J. Denny, manager research department. Head office, Excelsior Life Building, Toronto.

The stock of the Nipissing Mining Company is held by the Nipissing Mines Company, Limited, of Ontario, which on September 29th, 1917, acquired the assets of the old holding company, known as the Nipissing Mines Company. The officers of the holding company are: E. P. Earle, president; Alexander Fasken, secretary; P. C. Pfeiffer, treasurer; directors, W. H. Brouse, R. T. Greene, E. P. Earle, August Heckscher, David Fasken, J. H. Black, R. B. Watson. Head office, 165 Broadway, New York.

The yearly average price at which silver was sold was 83.19 cents per ounce at Cobalt, which was nearly two cents per ounce higher than the New York yearly average quotation. The total dividends paid to January, 1918, amounted to $16,750,000.

The production of fine silver was 4,212,247.89 ounces having a gross value of $3,756,889.77.

Production costs were $1,057,987.49, equivalent to $14.26 per ton of ore milled, and 25.117 cents per ounce of silver produced, an increase of about one cent per ounce over 1916.

The ore reserves are estimated to contain 8,076,540 ounces of silver as compared with 9,153,139 ounces at the close of 1916.

Underground work done in 1917 is summarized as follows:—

Shaft No.	Drifting	Cross-cutting	Raising	Sinking	Total	Stoping
	ft.	ft.	ft.	ft.	ft.	cu. yds.
14	.....	.....	.....	.....	.....	208.7
64	.....	.....	33.0	.....	33.0	152.0
73	1,027.0	2,082.5	286.0	89.5	3,485.0	8,471.0
80	6.0	1,118.5	49.5	.....	1,174.0	726.8
81	1,827.5	1,278.5	1,102.0	.....	4,208.0	15.5
96	221.5	611.5	268.5	.....	1,101.5	2,447.6
Total	3,082.0	5,091.0	1,739.0	89.5	10,001.5	12,061.6

Notwithstanding continued heavy increases in the cost of materials and supplies, especially chemicals and articles of iron and steel, the company had one of the most prosperous years in its history. The net value of production was $3,665,405, which was $710,000 more than in 1916, heretofore the highest year for net value received.

Northern Customs Concentrator.—The Northern Customs Concentrators, Limited, situated at mileage 104, T. & N. O. railway, ran continuously in 1917. The ore treated was shipped by La Rose, Right-of-Way, Chambers-Ferland, and a small quantity by Edwards and Wright from the Green-Meehan dump.

The officers are: President, A. J. Young, 702 Excelsior Life Building, Toronto; vice-president, C. J. Booth, Ottawa; general manager and secretary-treasurer, F. J. Bourne, Cobalt; directors, M. J. O'Brien, Renfrew; Dr. C. W. Haentschel, Haileybury.

O'Brien.—Development at the O'Brien mine during 1917 was as follows:—

Drifting and cross-cutting	6,710 feet.
Raising and sinking	410 "
Stoping	42,550 tons.
Hoisted to surface	69,950 "

A new low level was established at 720 feet below the collar of the main shaft and ore mined at this level.

A new shaft, No. 33, was sunk on the southwest quarter of the property, and levels established at 150 and 180 feet. About one-half of the total production came from the Keewatin formation. In the mill, changes were made to effect greater concentration. After concentration the entire tailing product is slimed and cyanided. The mill treated 47,850 tons.

The mine is now owned and operated by M. J. O'Brien, Limited, a new corporation organized during 1917.

The officers are: President, M. J. O'Brien, Renfrew; vice-president, J. A. O'Brien, Renfrew; manager, J. G. Dickenson, Cobalt; mining engineer, Angus Campbell; mine secretary, A. E. McKee.

Ophir.—The Ophir Cobalt Mines, Limited, has a capitalization of 1,500,000 shares of a par value of $1.

The directors of the company are: H. H. Lang, A. D. Crooks, H. H. Hutson, Wm. Linton, W. Murray Alexander, all of the City of Toronto; the head office is 608 Lumsden Building, Toronto.

The Ophir mine operated continuously during the year 1917. The arrangement whereby the underground development is done through the shaft of the People's Mining Company was continued during the year. Most of the underground work was done on the 140-foot level. A winze was started to prospect the downward continuation of a promising ore shoot on this level.

Balmer Neilly of the Penn-Canadian mine is consulting engineer of the company.

Penn-Canadian.—The Penn-Canadian Mines, Limited, operated continuously throughout the year 1917, though on a reduced scale. Very little development

work was done. The mill treated 34,000 tons of ore, produced largely from the old workings. On May 10th, 1918, the power plant was destroyed by fire.

The officers are: President, Wm. J. Haines, Philadelphia; directors, Spencer D. Wright, Philadelphia; Robert B. Haines, Jr., Philadelphia; Jansen D. Haines, Des Moines, Iowa; Elliott C. P. Laidlaw, New York. Balmer Neilly, Cobalt, is manager of the company.

People's.—The working agreement between the People's Silver Mines, Limited, and the Ophir Cobalt Mines, Limited, mentioned in the last annual report of the Bureau of Mines, was continued throughout 1917. Development of the Ophir ground has proved satisfactory and some promising veins have been encountered.

Cross-cutting and drifting were done by contract, let to Messrs. Cain and Smith, under the direction of mine captain Donaldson.

Balmer Neilly, manager of the Penn-Canadian is consulting engineer for the company.

The officers of the People's company are: President, G. P. Bithell, 773 St. Lawrence Boulevard, Montreal; vice-president, James Robertson, Millerton, N.B.; secretary-treasurer, T. Jones, 773 St. Lawrence Boulevard, Montreal.

Ten men were employed by the contractors.

Peterson Lake.—The Peterson Lake Silver Cobalt Mining Company, Limited, worked continuously during 1917. The cross-cut to the northwest at the 200-foot level of the Susquehanna shaft was extended, and in July a vein was encountered. Further developments were not encouraging, and work was suspended. The force was moved to the Cart Lake section at the Gould No. 2 shaft, where work was continued. Total development at the Susquehanna and Gould shafts in drifting, cross-cutting, sinking and raising for the nine months ending January 31st, 1918, amounted to 1,050 feet.

The officers are: President, W. A. Lamport; vice-president and managing director, S. G. Forst; secretary-treasurer, P. M. Goff, all of Toronto; directors, W. A. Lamport, S. G. Forst, Chas. M. Nickel, Max B. Borg, New York; Irving L. Ernst, New York. Head office, 909 Excelsior Life Building, Toronto.

Prince-Davis.—Operations through the Lumsden shaft by the Prince-Davis Mining Company, Limited, on the Prince lot in southeast Coleman, were discontinued in April, 1918. A cross-cut was run over 850 feet on the Prince ground, but developments were not encouraging.

Underground work was in charge of Captain Donaldson. Balmer Neilly, manager of the Penn-Canadian is consulting engineer for the company.

Eight men were employed by contractors Gordon and Robert Cameron.

Provincial.—Under the direction of John Redington, the mill of the Cobalt Provincial mine was enlarged, and during the winter of 1917-18, 1,000 tons of tailings were treated. No. 2 shaft was de-watered to the 175-foot level and work resumed in the cross-cut to No. 1 shaft. There is considerable ground on the south side of the property, as yet not prospected, and it is the intention of the management to carry on active underground development during the coming year.

Right-of-Way.—The Right-of-Way Mines, Limited, did a small amount of development work during 1917. Operations were confined to No. 2 shaft at the north end of Cobalt lake. Development during the year at No. 2 shaft was as follows:—

Sinking	82 feet.
Raising	110 "
Drifting	352 "
Cross-cutting	88 "
Total	632 "

Work on the 465-foot level to the close of the year had not proved satisfactory, but development was still in progress. The net value of ore produced during 1917 amounted to $45,506.61.

The officers are: President, E. Seybold; secretary-treasurer, E. A. Larmonth; director, C. Jackson Booth, all of Ottawa. A. W. Fraser, K.C., of Ottawa, who had been a director and vice-president of the company since its incorporation, died on August 11th, 1917. D. H. Angus, Cobalt, is superintendent, and the head office of the company is at Central Chambers, 16 Elgin Street, Ottawa.

Shamrock.—The Shamrock Consolidated Mines, Limited, worked with a small force for the greater part of the year, and closed in November, 1917. Development consisted of drifting on the 200 and 300-foot levels, and a small amount of stoping on the latter.

H. S. Anderson, 93 Queen St. East, Toronto, is secretary of the company, and J. P. Cleveland was in charge of operations at the property.

Silver Queen.—In June, 1917, the Silver Queen mine was leased to Geo. A. Irwin, of Cobalt, who worked it with a small force of men during the balance of the year. A car of ore was shipped in September, and a second car in March, 1918. The ore was obtained mostly from the old dumps and from wall-slashing on the first level. There is considerable milling ore in sight, and if proper milling arrangements can be made, the output for 1918 should be considerably increased.

Temiskaming.—The following information is taken from the eleventh annual report of the Temiskaming Mining Company, Limited, for the fiscal year ending December 31st, 1917. This report was issued by the old board of directors, as given in the last annual report of the Bureau of Mines. During the year 1917 Frank L. Culver was president and general manager of the company. Head office is at Lumsden Building, Toronto.

The main shaft was sunk to the 1,600-foot level, through the diabase sill, and considerable development work at that level failed to disclose commercial ore. Development is being continued.

Production during the year amounted to 958,669.88 ounces of silver. The cost of production was 31.56 cents per ounce.

Following is a summary of development:—

Drifting	1,371.0	feet.
Cross-cutting	2,677.5	"
Sinking	117.1	"
Raising	701.5	"
Winzing	28.4	"
Total	4,895.5	"
Stoping	4,455.5	cubic yards.

Four dividends of $75,000 each were paid during the year.

Three Stars.—The Three Stars Silver Mines, Limited, was organized early in 1918 and resumed work March 1st, 1918, on the Cyril lake or Airgoid property, worked during 1916 by the Calumet and Montana Consolidated Mining Company, Limited. The capitalization of the new company is $3,000,000, divided into 600,000 shares par value $5 each.

Operations were suspended in May, 1917, by the Calumet company.

The north cross-cut on the 90-foot level is being extended, and drifting is in progress on a promising vein running directly east from the cross-cut.

The officers are: President, Henry A. Oswald, Cobalt; vice-president, K. J. Schumacher, Chicago; secretary-treasurer, H. R. Mendis, Chicago. The board of directors includes the above officers, R. G. Collins, and Chauncey W. Martyn, of Chicago.

Trethewey.—The mine and mill of the Trethewey Silver Cobalt Mining Company, Limited, operated throughout the year. Very little new ground remained for exploration, and as a result development was discontinued in June, 1917, and work confined to the old stopes. Drifting and cross-cutting amounted to 463 feet, raising and winzing to 12 feet. The net decrease in tonnage of ore reserves at the close of 1917 amounted to 13 per cent., while the estimated ounces of silver in the ore reserves decreased from 361,482 to 264,044 ounces, a net decrease of 27 per cent. A total of 23,013 tons of ore was broken in the stopes, at a cost of $2.60 per ton. Most of this production came fom the walls of old stopes. The mill treated 31,722 tons of ore, having an average content of 13.3 ounces, at a cost of $1.744 per ton treated, including all charges from the shaft-house bins. From this ore, 341,278.23 ounces of silver were obtained. The average assay of the tailings was 3.2 ounces, giving an extraction of 75.2 per cent. High-grade concentrates were shipped to Deloro and Thorold, and low-grade ones to Denver. The net value of ore produced was $259,208.60, leaving a profit of $114,977.33. The total cost per ton produced, including marketing charges, was $4.827.

Rochester Mine.—Operations were discontinued at the Rochester, March 1st, 1917. The third level was considered fully explored, and it was decided to make no further expenditures. The total expenditures on the Rochester during the year amounted to $14,549.17.

Cane Silver Mine.—The Trethewey company secured an option on three claims known as the Caroux claims in Cane township, in June, 1917, and carried on operations for a period of six weeks. Considerable stripping was done and a

shaft sunk to a depth of 40 feet. There were several strong fractures on the surface showing good values, but operations were closed in August.

The officers are: President, S. R. Wickett, Toronto; vice-president, J. B. Tudhope, Orillia; secretary-treasurer, L. J. Pashler, Toronto; directors, Gordon Taylor, Toronto; J. P. Bickell, Toronto; W. J. Sheppard, Waubashene; T. E. Leather, Hamilton. The head office is at 1428 Traders' Bank Building, Toronto.

I. S. McReavy, Cobalt, is manager, succeeding H. S. Robinson, who returned to the United States in August, to join the overseas forces.

Gowganda and Elk Lake Silver Mines

During 1917 the Gowganda area received considerable attention from mining companies in search of new properties. This interest was no doubt due to the discovery in 1916 of high-grade ore on the O'Brien property at Miller lake, and the increased selling price of silver. A large number of claims have been patented and held since 1910 by the older operating companies of Cobalt and Porcupine, and it is probable that some of these claims may become producing mines through systematic prospecting and development.

In the Elk Lake section some work was also done.

Bishop.—The Bishop Silver Mines, Limited, operated only part of the year on their claim L.O. 313, situated on the east side of Calcite lake, township of Lawson. The winze near the end of the main drift was sunk to the 100-foot level, and a small amount of cross-cutting done. Previous development is described in the Twenty-sixth Report of the Bureau of Mines. The mine was closed on April 30th, 1917, and no further work was done during the year.

Wm. J. Shields was manager of the mine.

Castle.—At the beginning of the year the Trethewey Silver Cobalt Mining Company, Limited, secured an option on the control of the stock of the Castle Mining Company, Limited. The holdings comprise eleven claims near Miller lake, in the Gowganda district. Eight of these claims lie along contacts very favourable for ore deposition.

Prospecting and surface development were carried on during the summer and fall of 1917, and during the winter a plant was taken in and installed. The plant includes two 60-h.p. boilers; one 8 by 10 Jenckes hoist; one Rand compressor, 720 cubic feet capacity. Sinking operations were started in May, 1918.

R. E. Margenau was superintendent for the Trethewey Company.

Crews-McFarlan.—Early in the year the Crews-McFarlan Mining Company, Limited, purchased the Bartlett property in the township of Milner, in all about 132 acres. On this property were two vertical shafts, No. 1, 110 feet deep, and No. 2, 110 feet. Most of the force from the Hewitt Lake workings were transferred to the Bartlett, and active development commenced July 15th, 1917. Both shafts were de-watered and re-timbered and sinking was resumed.

At the Hewitt Lake property shaft No. 1 was sunk to a depth of 150 feet, and work on this claim was stopped. On claim J.S. 280, No. 2 shaft was 140 feet deep with sinking in progress, when last inspected in October, 1917.

The officers are: President, C. H. Streit, Nutley, N.J.; secretary, Henry Crews, Paterson, N.J.; treasurer, W. J. McFarlan, Paterson, N.J.; manager, J. G. Wheaton, Gowganda P.O.; 25 men were employed during the year.

Kenabeek.—During 1917, the Kenabeek Consolidated Silver Mines, Limited, worked intermittently, and did a small amount of development on their property, south half of lot 2, in the sixth concession of Auld township. The shaft was sunk to the 150-foot level, and 82 feet of cross-cutting and drifting done, chiefly on No. 2 vein. A small prospect winze was sunk on the intermediate vein.

The head office of the company is at 232 St. James Street, Montreal, and the officers are: President, Frank Thompson; director, E. Champagne; manager, Capt. W. H. Jeffrey. George Pyke, formerly secretary-treasurer, died during the year.

Miller-Lake O'Brien.—Production at this mine during 1917 placed it among the first half-dozen silver producers of Canada.

Development during the year was as follows:—

Drifting and cross-cutting	1,907	lineal feet.
Raising and sinking	90	" "
Stoping	12,324	tons.
Hoisted to surface	18,200	"

A fine new office building, with sleeping quarters for the staff, was built during the year.

The mine is owned and operated by M. J. O'Brien, Limited, with the same officers as given for the O'Brien mine at Cobalt, with the addition of B. C. Crowe as resident superintendent.

Reeve-Dobie.—The Reeve-Dobie Mines, Limited, resumed operations in April, 1917, and worked with a small force for the balance of the year. A shipment of high-grade ore was taken from an open-cut about 150 feet from the main shaft. During the summer the mill was repaired, and in September the main shaft was de-watered. The mill equipment includes four Nissen stamps, four Deister tables, one Risdon-Johnston concentrator, and one jaw crusher.

Mr. A. S. Crowe, formerly of the Porcupine Crown staff, took over the management on November 1st. During the winter one machine crew was employed cross-cutting on the 100-foot level.

The officers are: President, Charles Ward, Livonia, N.Y.; vice-president, H. Marvin, Rochester, N.Y.; secretary, J. C. Roche, Rochester, N.Y.; treasurer, Dr. J. H. Fennessey, Rochester, N.Y.

The property comprises claims S.W. 3, 4, and 5, on the Mann ridge, west of Gowganda lake. S. Christopherson was in charge of operations until November 1st.

T.C. 177.—The T.C. 177 Mining Company, Limited, worked continuously on their claims south of the Miller-Lake O'Brien property.

Camps were erected in February, 1917, and when visited on September 27th, 1917, a vertical shaft had been sunk to a depth of 77 feet, with sinking in progress. In May, 1918, the shaft had reached the 200-foot level and cross-cutting had been started. The plant includes one 10-h.p. locomotive boiler, one 4 by 5 hoist, and a small compressor.

Miles Simpson, Elk Lake, was manager, and Joseph Brevier, mine captain.

Walsh.—What were known locally as the Walsh claims, in the Miller Lake section of the Gowganda district, were optioned during the year to the Crown Reserve Mining Company of Cobalt. A small plant was installed, a shaft sunk 100 feet, and a small amount of lateral development performed during the year. Work was under the direction of H. J. Stewart, manager of the Crown Reserve.

Lorrain and South Lorrain

During 1917 the chief operating company was the Pittsburg-Lorrain Syndicate, working on the Currie mine. The Bellellen was closed for several months of the year. From March 20th to July 15th there was no development work carried on, although the pumps were kept running. The Lorrain Consolidated, formerly known as the Harris property, closed down on June 15th, 1917. The Pittsburg Lorrain shipped considerable high-grade ore, and late in the year took over the Wettlaufer mill and mine under lease.

In the spring of 1918 the Keeley mine, formerly one of the chief producers, was examined, and a shipment made of ore in stock from previous operations. It is probable that this mine will be worked during 1918.

Bellellen.—The syndicate operating the Bellellen, on claim R.L. 470, South Lorrain, continued development from the first of the year to March 20th, 1917, when all operations except pumping were suspended. On July 15th work was resumed until the close of the year.

The winze on the 100-foot level was sunk to a depth of 235 feet, and at the 200-foot winze level a drift was run to the south, a distance of 100 feet.

The members of the operating syndicate are as follows: Charles Richardson, Haileybury, manager; Arthur Ferland and R. T. Shillington, of Haileybury, and J. H. Black, Toronto.

Sylvester Carroll was in charge of operations, employing ten men.

Curry.—Development of the Curry mine, in South Lorrain, was continued during 1917 by the Pittsburgh-Lorrain Syndicate. Some high-grade ore was stoped on the fourth level. In August, 1917, the syndicate acquired the Wettlaufer mine and mill under lease. Operations at the Curry mine were suspended, and during the autumn of 1917 the Wettlaufer dump was milled. At the Wettlaufer about 750 feet of drifting and cross-cutting were done on the third and fourth levels, but no new veins were discovered. Underground work at the Curry mine was resumed and the mill has since been treating Curry ore.

The mill has been enlarged and the grinding capacity increased by the addition of one 5 ft. by 3 ft. ball mill. An experimental Groch flotation unit was installed. Exploration by diamond-drilling was carried on extensively at the Curry mine during the year.

H. F. Strong is superintendent, employing 10 men; John A. Rice is consulting engineer. Thomas B. Rice, who had been superintendent for the past three years, left in September, 1917, to join the American overseas forces training in Texas.

Maple Mountain Area

White Reserve.—Work was continued throughout the year by the White Reserve Mining Company, Limited, on its claims in the Maple Mountain area, Timagami Forest Reserve.

The main shaft is 147 feet deep, with levels at 70 and 140 feet. Development on the 70-foot level consists of 215 feet of cross-cutting and drifting, and on the 140-foot level north of the shaft, 492 feet of cross-cutting and drifting; south of shaft, 330 feet of cross-cutting and drifting. No. 21 shaft is 90 feet deep, with 110 feet of drifting at the 30-foot level. No. 10 shaft is 50 feet deep, and No. 14 shaft, 30 feet deep.

J. A. McAndrew, 408 Lumsden Building, Toronto, is president and general manager of the company.

IV.—EASTERN ONTARIO

Iron Pyrites

Bannockburn.—The Bannockburn Pyrite Mining Company has opened up what is known locally as the "Mundic" mine, on lot 25, con. VI., Madoc township. The open pit on this property is about 50 feet wide by 100 feet in length and 60 feet in depth. The equipment includes two small boilers and a hoist. J. A. Anderson, Bannockburn, is manager.

Caldwell.—Development was continued during the year on the pyrite property owned by T. B. Caldwell, of Lanark, on lots 1 and 2, in the first concession of Blithefield township. The shaft was continued to the 100-foot level, and 250 feet of cross-cutting and drifting done at this level. In October, 1917, the property was optioned to the Grasselli Chemical Company. During the winter and spring of 1917-1918 about 2,500 feet of exploration by diamond-drilling was done by the Sullivan company. In June, 1918, a wagon road was being built from Clyde Lake siding to the mine, and preparations were under way for extensive development by the new owners.

D. S. Tovey is superintendent for the Grasselli Chemical Company.

Sulphide.—The Nichols Chemical Company, a subsidiary of the General Chemical Company of New York, operated its pyrites mine and chemical plant at Sulphide, Hastings county, to full capacity during the year. The mine and plant are located on lot 23, in the eleventh concession of the township of Hungerford. The same company operates pyrites mines at Northpines and Goudreau, in the Lake Superior region of Ontario.

The enlargement of the chemical plant continued during 1917, the increased demand for acid being met by the installation of additional pyrites burners. The consumption of crude sulphur also increased during the year.

At the mine there was no addition to the equipment. The ore was extracted from the first, second, third, and fourth levels.

During the year a recreation hall, including bowling alleys, billiard tables and moving picture fixtures, was built at the plant for the company's employees. This

recreation club is operated by a committee of the employees, which pays the company interest on the capital expenditure and is in full control of the operation of the club.

W. H. DeBlois is manager, employing 150 men at the chemical plant and 35 men at the mine.

Queensboro Mine.—This mine, near Queensboro, in the township of Madoc, is owned and operated by the Canadian Sulphur Ore Company.

Sinking was continued to the 400-foot level and will be continued to the 500-foot level during the year 1918. The fourth level was extended east and west to the extent of the ore bodies in No. 3 shaft.

Good-sized ore bodies have been blocked out in No. 2 shaft, and No. 3 workings connected with No. 2 by means of a winze from No. 2 and a raise to connect from No. 3.

The officers of the company are: Alex. Longwell, Toronto, president; Geo. H. Gillespie, Madoc, vice-president; H. F. Smeaton, Queensboro, superintendent. Eighty men were employed during the year.

Copper

Cashel Copper Mines, Limited.—This company, operating on the east half and the south 20 acres of the west half of lot 31, in the first concession of Cashel township, near Gilmour, Hastings county, continued sinking a shaft to a depth of 80 feet, when work was discontinued.

C. S. Crysler is president and manager; W. Younger, vice-president; E. W. Storer, treasurer; S. B. Dawson, secretary.

Gold

Cordova Mines, Limited.—The Cordova mine is situated in Belmont township, Peterborough county, 12 miles by wagon road northeast of Havelock, and 112 miles east of the city of Toronto. After the disastrous fire on March 13th, 1917, which destroyed the shaft-house, mill, etc., rebuilding operations were commenced, but, owing to labour conditions and the difficulty of procuring supplies, it was not considered advisable to attempt to replace the plant at the present time.

Peter Kirkegaard is managing director; the head office is at Cordova Mines, Ont.

Cobalt-Frontenac Mining Company, Limited.—Mining rights owned by this company in Eastern Ontario include the following properties:—Lots 24 and 25, concession VI., township of Kaladar, known and described in previous reports as the Golden Fleece mine; north half of lot 26, and the southwest quarter of lot 27, concession VII., township of Kaladar, and lot 33, concession 1, township of Barrie, a total of about 700 acres.

On the Scootamatta river, near the village of Flinton, the company has completed the construction of a hydro-electric power plant, which has been developed as a source of electrical energy for the Golden Fleece mine. The erection of a 200-ton ore bin has just been completed, on the top of which has been installed a

14 by 24 Mitchell crusher with a capacity of 300 tons in ten hours. The ore will pass through the crusher into the ore bin, thence by means of an automatic feeder will be fed through a small Dodge crusher into a 60-ton ore bin. A stamp mill and a 5 by 16 tube mill in closed circuit with a Dorr classifier will be used for the further reduction of the ore. A Dorr continuous decantation cyanide plant with a capacity of 200 tons per twenty-four hours has been ordered, shipment of which will be made about the first of June. A two-stage, belt-driven Ingersoll Rand air compressor has been purchased and is being installed. Two 100-h.p. electric motors (power for which will be furnished by company's own hydro-electric power plant) have been installed for the operation of the mine and mill. The ore will be treated by amalgamation until such time as the cyanide plant is completed.

On the 1st of May, 1918, the company's head office was moved from Hamilton to the Golden Fleece mine, Flinton, Ontario.

The officers of the company are: George W. Millen, president, Winona, Ontario; M. G. Notz, secretary-treasurer, Hamilton, Ontario; D. H. Fletcher, managing director, Hamilton, Ontario; W. E. Simpson, consulting engineer, Flinton, Ontario.

Ore Chimney.—This mine, situated near Northbrook, in the township of Barrie, Frontenac county, is operated by the Ore Chimney Mining Company.

Up to January 1st, 1918, there had been 2,000 feet of cross-cutting and drifting done on the six several levels. The raise to the second or auxiliary shaft is almost completed.

At the mill, since the last Report, which gave a list of the machinery installed, there has been added one No. 2 Ding magnetic separator and a 200-h.p. generator.

The officers of the company are: A. E. Fletcher, president, and O. E. Dores, secretary-treasurer.

Iron

Playfair.—The Playfair hematite mine, which had been abandoned for upwards of forty years, was re-opened in the autumn of 1917 by the Canadian Union Iron Mines Company. Head office, Dominion Express Building, St. James Street, Montreal. H. L. Coombs, president.

A contract was let to L. Lemoine, of 521 Lafontaine Park, Montreal, to de-water the shaft, and mine 1,000 tons of ore. The property is located near Playfairville, in the township of Bathurst, Lanark county. When inspected on June 11th, 1918, the shaft, said to be 110 feet deep, was de-watered to a depth of 75 feet, and ore was being shipped from Perth, a wagon haul of twelve miles.

The vein where exposed varies from 2 to 4 feet in width, and Mr. Lemoine stated that the ore was of excellent quality for blast-furnace use.

Talc

Connolly Mine.—The Anglo-American Talc Corporation, Limited, owns and operates what is known as the Connolly mine on the northwest quarter of lot 15 in the fourteenth concession of the township of Huntingdon, adjoining the village of Madoc in Hastings county.

H. S. Predmore is president of the company; R. J. Gilchrist, secretary; Thos. Carswell, resident manager; on an average 20 men were employed during the year.

The underground work during the year consisted in sinking the shaft to a depth of 188 feet, and drifting on this level east 275 feet and west 100 feet. On the 127-foot level the east drift was continued to a point 288 feet and the west drift to a point 100 feet from the shaft.

The mill commenced grinding in May, 1917, and was run continuously throughout the remainder of the year. Some crude talc was shipped in addition to the mill product. The mill has a daily capacity of 25 tons.

Geo. H. Gillespie and Co.—This company operates a talc-grinding plant at Madoc station on the Grand Trunk railway, the talc being all obtained from the Henderson mine operated by Cross and Wellington.

The plant ran continuously throughout the year, although part of the time at only about two-thirds the capacity, due to shortage of railway cars in which to ship the refined product.

Eighteen men were employed in the mill during the year; Geo. H. Gillespie is general manager.

Henderson Mine.—Messrs. Cross and Wellington, who have this mine under lease, operated continuously during the year. The mine is situated near Madoc in Hastings county. The greater part of the production is supplied to George H. Gillespie and Company, Limited, at Madoc, though some crude ore is shipped.

The production, which amounted to about 11,000 tons, came entirely from the sub-levels between the second and third levels, where the top-slicing and retreating method of mining is followed.

No. 2, or the east shaft, was sunk to the third level at a depth of 231 feet, and a connection made on this level with No. 1 shaft. A plant was installed at the shaft consisting of a 235-cu. ft. compressor, a 10-h.p. motor and an 8 by 10 hoist. The ore will be hoisted in a 21-cu. ft. skip.

Fourteen men were employed on an average during the year. Stephen Wellington is manager.

International Pulp Company.—On lot 16 in the fourteenth concession of Huntingdon township the International Pulp Company of Gouverneur, N.Y., is prospecting for talc. An incline shaft has been sunk to a depth of 50 feet, and it is the intention to cross-cut from this level.

A small plant, including compressor, hoist and boiler, has been installed. D. Brownson is manager, employing eight men.

Fluorspar

Fluorspar was found in 1918 on the Schickler farm on lot 8, concession XXII, Cardiff township, near the village of Harcourt on the Canadian Northern railway in Haliburton county. The vein is of good width, the fluorspar, which is of the violet-blue variety, being associated with calcite. Crystals of apatite were also noticed in the vein material.

P. J. Dwyer, of Wilberforce, has the property under option.

Bailey.—The Bailey property is situated on lot 1 in the fourth concession of Madoc township. The shaft is 40 feet deep, and 35 feet of drifting has been done at the 40-foot level.

This deposit was opened up late in 1916 by the Hungerford Syndicate (Harry Hungerford and Robert Gilchrist). Robert Phillips was in charge of operations.

The vein matter is well crystallized, and some first-rate spar was taken out during development.

Canadian Fluorite, Limited.—This company, through J. W. Bradley, is operating the Kane property, lot 9 in the fourteenth concession of Huntingdon township, from which shipments are being made to the new steel plants of British Forgings, Limited, at Toronto. The shaft is 25 feet deep on a vein about 9 feet wide. The vein matter is largely calcite. At the 25-foot depth there is considerable fluorite in the vein.

The plant consists of a 325-cu. ft. compressor, 35-h.p. upright boiler, and an 8 by 12 hoist.

E. D. Hall is superintendent, employing 10 men.

Noyes.—Canadian Industrial Minerals, Limited, is the name of the company operating the property formerly known as the Noyes and owned by Wellington and Munro. The company has a capitalization of 500,000 shares of a par value of $1.00. The officials of the company are: J. P. Watson, president; W. R. P. Parker, vice-president; G. M. Clark; and W. W. Perry, secretary-treasurer. The head office of the company is at 1512-1520 Bank of Hamilton, Toronto.

The company owns the following parcels totalling about 800 acres: lot 13, con. XII; lot 14, con. XI; lot 15, con. X, lot 16, con. IX, and the N. ½ of W. ½ of lot 12, con. XI, all in the township of Huntingdon.

The present workings are confined to part of lot 13, con. XII. An incline shaft has been sunk to a depth of 100 feet on a vein of fluorspar which averages from 8 to 12 feet in width at this point. On the 50-foot level drifts were run 85 feet to the south and 55 feet to the north.

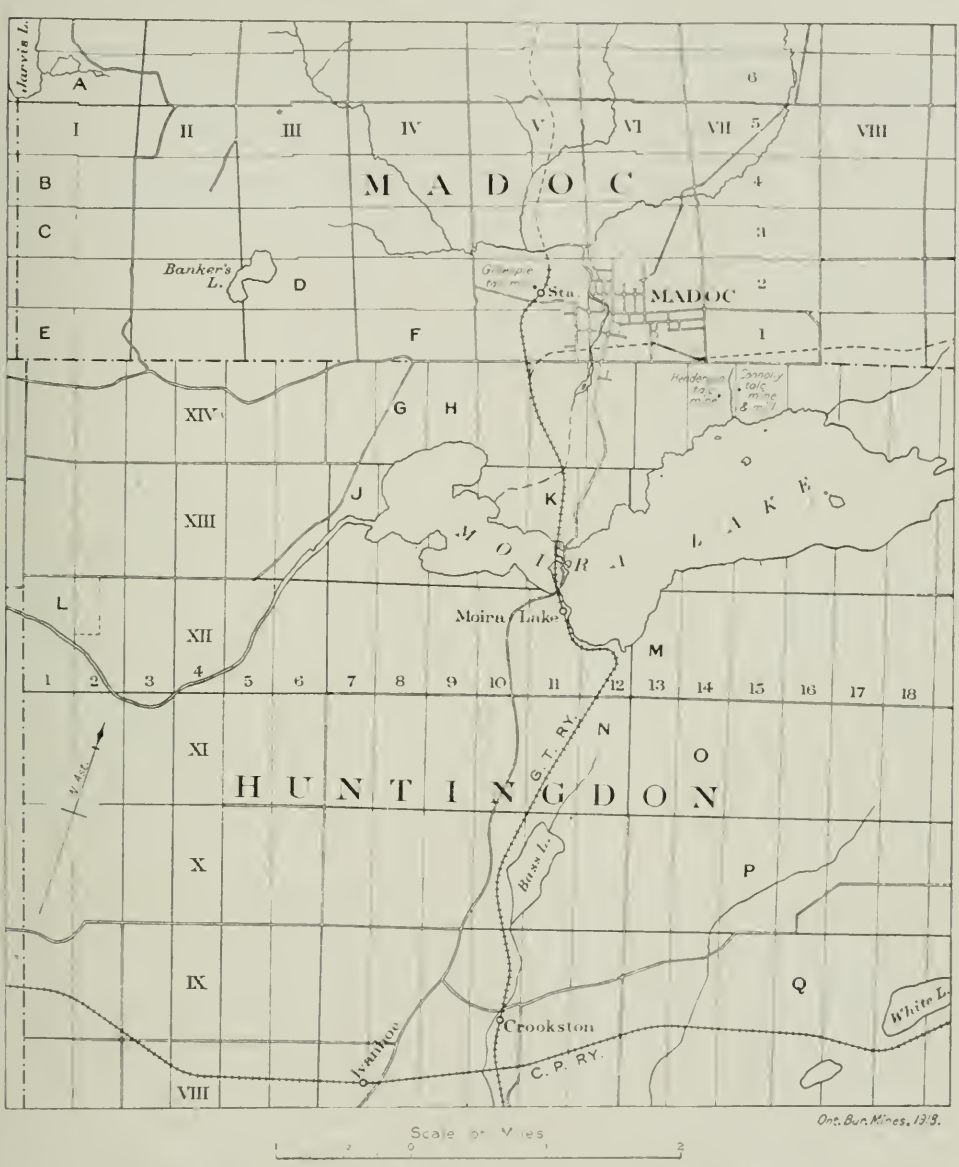
The present equipment includes a small boiler and a hoist and small compressor. A 784-cu. ft. compressor, electrically driven by a 125-h.p. motor, is being installed. The company has a railway siding at Moira Lake station about half a mile from the property. A. W. Grierson is resident manager, employing 18 men.

Cross and Wellington.—From the Perry property, on lot 11 in the thirteenth concession of Huntingdon township, about 2,000 tons of ore were shipped during the year.

No. 1 shaft, on the shore of Hog lake, is 35 feet deep. No. 2 shaft is 1,050 feet north of No. 1 shaft. No. 3 shaft, 175 feet north of No. 2, was sunk to a depth of 95 feet during the year. This property was shut down on December 1st, it being decided not to attempt any further mining until an adequate pumping plant was installed.

The power house contains a 170-cu. ft. compressor, a 75-h.p. motor and an 8 by 10 hoist.

Stephen Wellington is manager, employing 10 men.



Map of parts of the townships of Madoc and Huntingdon, showing location of fluorite properties near Madoc, Ont.

MADOC TP.

A.—Lot 6, Con. 1—O'Reilly.
B.—Lot 4, Con. 1—Wallbridge.
C.—Lot 3, Con. 1—Ponton.
D.—Lot 2, Con. 3—McIlroy.
E.—Lot 1, Con. 1—Lee.
F.—Lot 1, Con. 4—Bailey.

HUNTINGDON TP.

G.—Lot 8, Con. 14—North Reynolds.
H.—Lot 9, Con. 14—Canadian Fluorite, Ltd.
J.—Lot 7, Con. 13—South Reynolds.
K.—Lot 11, Con. 13—Perry.
L.—Lot 1-2, Con. 12—Herrington.
M.—Lot 13, Con. 12—Canadian Industrial Minerals, Ltd.
N.—Lot 12, Con. 11—Canadian Industrial Minerals, Ltd.
O.—Lot 14, Con. 11—Canadian Industrial Minerals, Ltd.
P.—Lot 15, Con. 10—Canadian Industrial Minerals, Ltd.
Q.—Lot 16, Con. 9—Canadian Industrial Minerals, Ltd.

Herrington.—The Herrington property, lots 1 and 2 in the twelfth concession of Huntingdon township, has been leased by Chas. Henrotin. Thirteen tons have been shipped. The vein, which is about 18 inches in width, has been stripped for 250 feet.

Lee.—The Lee property, which is situated on the west half of lot 1 in the first concession of Madoc township, is held under lease by Chas. Henrotin. Five cars have been shipped from an open cut. The vein is 3 feet wide at its widest part. The open cut is 500 feet long and is in places 8 feet deep.

McIlroy.—This property, situated on lot 2 in the fourth concession of Madoc township, is operated by Mineral Products, Limited. The vein, which is one to three feet wide, is developed by a shaft and an open pit.

Perry.—From the Perry property, lot 2, concession XIII, Huntingdon township, operated by Cross and Wellington, about 3,000 tons of fluorspar has been shipped. The property is shut down at present owing to water trouble. It is the intention of its operators to install a double-action, motor-driven Cornish pump to overcome the difficulty.

There are three shafts which are respectively 35, 80 and 95 feet deep.

The plant consists of a 50-h.p. boiler, a 470-cu. ft. compressor driven by a 75-h.p. motor, and an 8 by 12 hoist.

Reynolds.—The South Reynolds property, situated on lot 7, concession XIII, Huntingdon township, is under option to Chas. Henrotin. Two carloads of fluorite have been shipped from an open cut on the vein; this vein is narrow, being under 18 inches wide. About 150 feet has been exposed in the open cut.

Wallbridge.—The Wallbridge property, situated on the west half of lot 1 in the fourth concession of Madoc township, has produced 380 tons of spar. The vein has been stripped 500 feet. It varies from one to three feet wide. A second vein, 700 feet west of the first, has been uncovered for 100 feet. In a pit 15 feet deep on this second vein at the boundary with the Ponton property, the vein is six inches wide.

On the Ponton property, the west half of lot 3 in the first concession of Madoc township, a vein stripped for 300 feet is up to 3 feet wide.

Lead

Galetta.—The Galetta lead mine and smelter, belonging to the Estate of James Robertson, are situated on Chats island, on lot 22 in the sixth concession of the township of Fitzroy.

The mine developed favourably during the year. On the second, or 185-foot level, the vein was drifted on to the east 391 feet and to the west 66 feet.

No. 2 shaft, which is a vertical, 3-compartment one, located 60 feet south of No. 1 and in the hanging-wall side of the vein, was sunk to a depth of 225 feet. From the bottom a drift was driven to the east 100 feet and stoping commenced. The mill was brought up to a capacity of 50 tons per day.

The smelter, which has a capacity of 18 tons of pig lead every 24 hours, operated about 50 per cent. of the time. The open Scotch hearth with automatic rabble is used. The grey slag from the hearth is stock-piled for future treatment in blast furnace.

During the year 18 dwelling houses were built for the employees. A. G. Munich is general manager, and C. M. Thompson mine superintendent; employing on an average 65 men.

Feldspar

Card.—The Card feldspar and flint quarry near Verona, owned by Senator Richardson, of Kingston, was opened in October, 1917. About 20 cars of feldspar and flint rock were shipped and the quarry closed in May, 1918.

Sam Hunter was in charge of operations, employing six men.

Feldspars, Limited.—Work was continued throughout the year 1917 in the Desert Lake quarry operated by this company near Verona in Frontenac county. The proposed changes in methods of transportation to track, mentioned in the Twenty-sixth Report, were not made during the year, and when inspected in June, 1918, the ore was being transported to Glendower siding in scows as before

Hoisting by derricks in open buckets has been abandoned, and all ore is lifted to the rock house in skips on the incline track, the loading pocket being located in a central position in the pit.

The entire spar production is now being utilized by the United States military authorities in the manufacture of insulating material. The ore was formerly transhipped from cars to boats at Kingston, but now crosses the lake on the Grand Trunk ferry operating between Cobourg and Genesee dock, where the grinding plant is located.

The officers of the company are: S. Harry Worth, president; Fred Zoller, Rochester, vice-president; R. F. Segsworth, Toronto, secretary-treasurer; the head office is at 103 Bay St., Toronto. Ralph Scott is superintendent, and George Gray assistant superintendent. An average force of 75 men was employed during 1917.

Feldspar Milling Company, Limited.—The feldspar grinding plant near Parham station, Canadian Pacific railway, is operated by this company, which was organized in 1917. During the year the plant was remodelled and grinding stones and a pebble mill added. The product is ground to 200-mesh and shipped to the trade in bags.

A. W. Adams was superintendent in 1917, and since March 1st, 1918, Geo. W. Hurlburt has been in charge.

The officers are: F. H. Hurlburt, president; Geo. W. Hurlburt, manager; Dr. Morrison, secretary-treasurer; head office, 33 Richmond Street West, Toronto.

Feldspar Quarries, Limited.—The quarry owned by this company, situated on the west half of lot 16 in the tenth concession of the township of Portland, was operated continuously during 1917. The product is teamed to Verona on the Canadian Pacific railway. The manager reports shipments of 6,000 tons of high-grade spar during the year 1917.

The pit when last inspected, on June 4th, 1918, was 150 feet long and 80 feet deep. A considerable body of spar was exposed, but a large tonnage of capping on the hanging-wall side required to be removed to permit of its recovery.

The head office of the company is at 33 Richmond Street, Toronto. George W. Hurlburt is manager, employing 15 men.

Eureka Flint and Spar Company.—This is an American corporation with head office and works at Trenton, N.J. For some years it has been one of the largest producers and purchasers of spar and flint rock in the United States and Canada.

Operations were commenced in October, 1917, on the Emery farm near Verona, on part of lot 16 in the tenth concession of the township of Portland. On June 4th, 1918, the open pit measured 125 feet long by 35 feet wide and 30 feet deep. The quarry adjoins the Hurlburt property. The plant consists of one upright boiler, 22-h.p., one Beatty hoist and one stiff-leg derrick.

Shipments are made from this quarry to the company's plant at Trenton, N.J., and the Canadian representative, John C. Wilkes, also purchases spar and flint for use in the pottery trade.

The officers of the company are: John E. Throp, president; Thos. H. Throp, vice-president; Frank W. Throp, treasurer; Peter D. Throp, secretary. Operations in Canada are in charge of John C. Wilkes, Verona.

National Potash.—The National Potash Corporation, Limited, has an authorized capitalization of 1,500,000 shares of a par value of $1.00. The directors are: E. L. Wettlaufer, Toronto, president; William Calder, Durham, general manager; D. J. Benham, Toronto, secretary; W. S. Milne, Toronto, treasurer; H. T. Whaley, Toronto. The head office of the company is at 178 Spadina Avenue, Toronto. The works and quarry are at Gravenhurst (Muskoka Wharf). S. J. McCarthy is works manager, employing 45 men.

The quarry is at present being operated for crushed rock for road material. The face of the quarry is about 60 feet in height. The work is done under contract and about 200 tons of rock are crushed daily. As shipped, the product runs from 3/8-inch to 2½-inch. The feldspar is being stockpiled until the smelting plant is completed.

The plant being installed comprises a blast furnace 192 in. by 42 in. with a capacity of 200 tons a day; one 175-h.p. engine; two 600-cu. ft. blowers, two 25,000 induction fans; two 325-h.p. B. and W. boilers; one 300-cu. ft. compressor, and one set of evaporators. It is electrically operated.

Orser and Kraft.—The feldspar quarry on lots 12 and 13 in the fifth concession of the township of South Sherbrooke, was worked at intervals during 1917. A siding was built at Mud Lake station on the Canadian Pacific railway, one and one-half miles from the quarry, and in the spring of 1918 regular shipments amounting to 100 tons per week were going forward.

In this quarry the radium-bearing mineral euxenite was found which is described by Dr. W. G. Miller and C. W. Knight in the Twenty-sixth Report of the Bureau of Mines.

Mica

Lacey.—The Lacey mine, near the village of Sydenham in Loughborough township, worked continuously during 1917. From July to December operations were carried on in the open pit, which is now 200 feet deep. During the winter months work was continued in the "milky vein" stope, a parallel ore body connected with the main shaft by a cross-cut about 60 feet to the southwest. This stope averages 16 feet wide and 200 feet long, and from the floor to the back in the deepest part of the stope is 80 feet. The ore is hand-cobbed underground and roughly trimmed in the shop at the shaft collar, before shipment to the company works at Sorel, Quebec, where it is finished for the market.

Henry Smith, for many years superintendent of this mine, died December 14th, 1917, and was succeeded by his brother, Richard Smith. The mine is owned and operated by the Loughborough Mining Company, Limited. George M. McNaughton is manager, and an average force of 25 men was employed during the year.

Sydenham Mica and Phosphate Mining Company, Limited.—The mica pit operated by this company in 1916 on lot 7 in the eighth concession of Loughborough township continued production till September, 1917, when work was stopped. The shaft was sunk about 50 feet, and the mica was trimmed at the company's shop in Sydenham. A hoist, gasoline engine and pump were installed.

The officers of the company are: Harry N. Kraft, president and treasurer; Jacob J. Stein, vice-president; A. B. Potter, secretary.

Molybdenite

International Molybdenum Company.—The only mine operated by this company in 1917 in Ontario was the Moran in Brougham township adjoining the O'Brien mine. Most of the ore mined was taken from an open cut, and the shaft was continued to a depth of 40 feet. The company is also a purchaser of molybdenite ores, having a custom concentrator at Renfrew and a smelter and refinery at Orillia.

At the concentrating plant at Renfrew three additional flotation machines were installed, and the capacity increased about 30 per cent.

The smelting plant at Orillia was operated for seven months when all equipment was transferred to a new plant, an additional electric furnace, new transformers and other equipment being added, thereby doubling the capacity of the old plant.

The officers of the company are: J. L. Murray, president; H. A. Jordan, secretary-treasurer and manager; B. C. Lamble, superintendent of smelter at Orillia; W. M. Weigel, superintendent of mining and milling. The head office of the company is in Renfrew.

The company manufactures molybdic acid, ammonia molybdate and ferromolybdenum.

Renfrew Molybdenum Mines, Limited.—The mine and concentrating mill of this company, situated on lots 8 and 9, concession XI, township of Brougham, operated continuously during 1917.

The officers of the company are: President, Jean Vanophen, 24 Rue Batallière, Paris, France; A. E. Goyette, vice-president, Montreal; secretary, R. LeAprohon; treasurer, P. C. Neault, Grand Mère, Que.; Chas. G. Titus, assistant vice-president and general manager, Mount St. Patrick.

During the year the 2-compartment shaft was sunk 75 feet to the 150-foot level, and about 600 feet of lateral development done.

Owing to lack of fuel for power, the mill ran only about 34 per cent. of the possible running time. The total production of molybdenite for the year was about 58,000 pounds. The concentrates averaged 95 per cent. MoS_2. A 96 per cent. recovery was made on ore averaging .74 per cent. MoS_2. The concentrates are shipped to France in barrels, the weight being about 1,000 pounds each. The mill has a daily capacity of 40 tons.

Owing to the difficulty of obtaining fuel, a transmission line was built to the power development on the Madawaska river at Calabogie and the plant electrified. One 5-h.p. and two 25-h.p. motors were added to the mill and a 100-h.p. motor to the compressor. Forty men are employed.

Spain.—The Spain mine, on lot 31 in the fourth concession of the township of Griffith, operated intermittently during the year. The production came principally from the open pit.

The mine address is Dacre, Ont., and the head office of the company is at 117 Fifth Avenue, New York. Ten men were employed.

Steel Alloys Corporation.—The Sunset mine, situated on lots 35 and 36, concession XIV, township of Brougham, is being operated by a company known as the Steel Alloys Corporation, of which H. E. Clarke, 27 William Street, New York, is president.

The ore body has been opened up by an open cut 10 feet wide, 100 feet long, the greatest depth of which is 35 feet.

The plant includes a 100-h.p. boiler, a 5 by 7 hoist and a 686-cu. ft. compressor. J. E. Cole, Dacre, Ont., is superintendent.

Molybdenum Products Company, Limited.—This company has a capitalization of 1,075,000 shares of a par value of $1.00. The head office of the company is at Wilberforce. M. B. R. Gordon is manager, employing 10 men.

The mine is located on lot 33 in the sixteenth concession of the township of Monmouth in Haliburton county, about half a mile from the village of Wilberforce. A 75-ton mill is in course of construction.

W. E. Joiner and Company.—W. E. Joiner is opening up a promising molybdenite property on the north half of lot 3 in the twentieth concession of the township of Cardiff, 1½ miles east of the town of Wilberforce. The work so far done consists of stripping and blasting and has exposed some very fine molybdenite ore. A small steam plant is being installed.

Pandash Lake Molybdenite Mines, Limited.—Mr. Joiner has also done some work on a molybdenite deposit on lot 18 in the ninth concession of Cardiff, the Mooney farm, about 15 miles southeast of Wilberforce. This property is known as the Pandash lake molybdenite mine.

Wilberforce Molybdenite Company, Limited.—On lot 33 in the fifteenth concession and on part of lot 33 in the fourteenth concession of the township of Cardiff, the above company is opening up a molybdenite prospect. P. J. Dwyer is manager. A concentrator is being erected at Wilberforce.

Graphite

The demand for all grades of Ontario graphite was very satisfactory to the producers throughout 1917.

Since January 1, 1918, the crucible trade has fallen off materially owing to adjustments in the iron and steel business, and this in turn affected the demand for crystalline flake graphite and broke the market price for that product. The crucible makers, on account of a lack of demand for their product, demanded a higher grade of graphite. As a result the producers of crystalline flake in New York, Alabama and Pennsylvania had large quantities of this grade rejected, and the same condition prevailed with regard to the Ontario product.

The demand for lubricating flake has also fallen off to a considerable extent, and large stocks have accumulated.

With regard to the intermediate and low-grade graphite products, which are consumed largely by foundries and the iron trade, the demand has also materially fallen off since the beginning of the present year, owing to unsettled conditions in the iron industry in the United States. This state of affairs is due to the inability of the foundries to secure raw material for any but essentially war production.

The effect has been to put the small foundries devoted to commercial production practically out of business, and as they consumed the bulk of foundry plumbago for facing purposes, the demand has greatly fallen off.

Black Donald.—The Black Donald Graphite Company, Limited, had in 1917, the largest production of refined graphite in the history of the company. The mine and mill are situated about 14 miles from Calabogie, in Renfrew county. The company owns mining rights on lots 17 to 20 in the first, second and third concessions of the township of Brougham.

In the autumn of 1917 the open pit was tagged over, and work was continued throughout the winter in the old workings under Whitefish lake. The ore shoot has widened out considerably and continues to be high-grade milling ore.

New plant installations included three General Electric transformers, 1,100 to 550 volts; one Ingersoll-Rand compressor, 500 cubic feet capacity, one Universal jaw crusher. A new blacksmith shop and machine shop were built and equipped, and 33 dwellings for employees were erected during the year 1917. The hauling capacity to the track at Calabogie was increased by the purchase of five motor trucks, hauling from 2,500 to 3,500 lbs. each per load, and making two round trips per day.

The officers of the company are: R. F. Bunting, president; G. H. Bunting, vice-president; J. N. Snead, secretary; John Patno, superintendent; 75 men are employed at the mine and mill.

Globe.—The Globe Graphite Mining and Refining Company, Limited, operated their mine continuously during 1917. The mine is situated on lots 21 to 23,

inclusive, in the sixth concession of the township of North Elmsley, and the ore is teamed to the mill on the Tay river at Port Elmsley, a distance of three miles. Considerable diamond-drilling was done during 1917 by Smith and Durkee of Sudbury. No. 3 vertical shaft was sunk to a depth of 100 feet, with 40 feet of drifting to the north at the 60-foot level and 40 feet at the 100-foot level.

The mill is equipped with the dry process of concentration, using the Sutton, Steele and Steele tables and air flotation. In the spring of 1918 experiments were in progress for the installation of an oil flotation unit. The drying kilns were improved and a large Telsmith ore crusher was installed. When inspected, June 11th, 1918, work on the No. 3 shaft had ceased, and the old workings were being de-watered.

The company produces three grades of finished graphite designated as: M. flake, containing 90 per cent. graphitic carbon and over; F. flake, containing between 65 and 85 per cent. graphitic carbon; D. grade dust, containing from 30 to 40 per cent. graphitic carbon.

The officers of the company are: Chas. A. Lux, president; George G. Fryer, secretary-treasurer; George H. Beebe, manager, all of Syracuse. The head office of the company is 410 Dillaye Building, Syracuse, N.Y. George N. Brewer, Port Elmsley, is superintendent, employing 55 men.

National.—National Graphite, Limited, did a small amount of development work on their property on lot 24 in the thirteenth concession of Monteagle township; the mill at Munfords, near Harcourt on the T. B. and O. railway, is being remodelled at the present time.

W. A. P. Schorman is president of the company, the head office of which is in the Royal Bank Building, Toronto. George Gill is superintendent of the mine and mill at Munfords.

Corundum

Manufacturers Corundum.—The Manufacturers Corundum Company, Limited, mined various small deposits of corundum in the townships of Raglan, Radcliffe and Brudenel during 1917. Most of the operations were conducted during the winter months, and the ore was stockpiled at the company's concentrating plant at Palmer rapids on the Madawaska river, lot 24, concession XVIII, township of Raglan.

The officers of the company are: D. A. Brebner, Toronto, managing director; A. W. Holmsted, Toronto, secretary; H. E. T. Haultain, Toronto, consulting engineer; E. B. Clarke, Jewellville is superintendent, employing on an average 35 men.

Quarries

Canada Cement Company.—The quarry and clay pit operated by the Canada Cement Company at Point Anne near Belleville was closed for the greater part of 1917. On August 1 work was resumed and carried on till the close of the year, when it was again closed till March 1, 1918. The working face is now 50 feet in depth, and all drilling is done by two Loomis power drills, using a 5⅝-inch bit. The broken stone is loaded on 8-ton cars by a Marion steam shovel.

and hauled to the crusher by a dinky locomotive, on a standard-gauge track. The Fairmont jaw crusher has a capacity of 1,000 tons per day.

H. L. Shock is manager, employing 20 men.

Point Anne.—The Point Anne Quarries, Limited, operated continuously during 1917. Ground-storage capacity for 75,000 tons was installed during the year with belt conveyor to boats and cars. The quarry is one-half mile long by 300 feet wide. Drilling is done with an Armstrong power drill, the holes being six inches in diameter and drilled to an average depth of 32 feet. The material shipped varies in size from ½-inch screenings to 8-inch lump for blast-furnace work. The officers are: M. J. Harvey, president; J. F. M. Stewart, manager; A. N. Harnwell, secretary-treasurer; A. G. Bennett, superintendent.

Hydro-electric power is used throughout the crushing plant and quarry. Fifty men were employed during the year.

V.—SOUTHWESTERN ONTARIO

Quarries

Beachville White Lime Company.—The quarry and lime kilns operated by this company near Beachville, adjoining the property of the Standard White Lime Company, were in continuous operation during 1917. The limestone, which in this district has a very high lime content, is quarried in two benches with a total face of 28 feet. At present only the bottom bench 8 feet in depth is being worked. A large percentage of the output is shipped to the Cyanamid Company at Niagara Falls, and to the Hamilton blast furnaces.

The officers of the company are: M. S. Schell, president; J. W. Blow, secretary-treasurer; C. E. Downing, manager.

Forty-two men are employed.

Canada Cement Company.—The cement plant and quarry operated by this company at Port Colborne worked with reduced capacity in 1917, and closed down completely in January, 1918, due to power shortage. The plant is well located close to the source of power at Niagara, but the large number of munition plants in the district have gradually absorbed all available power and forced other industries to close.

The quarry has a working face of 20 feet, drilling being done with a power drill. The broken rock is loaded into cars by two Marion steam shovels, a third Vulcan shovel being used for stripping.

S. R. Preston is manager, and L. M. McDonald, superintendent.

Canada Crushed Stone Corporation, Limited.—The large quarry and crushing plant operated by this company near Dundas, in the township of West Flamborough, was in continuous operation throughout the year. Its output of crushed limestone is the largest in the Province. The quarry is now worked in two benches, with a total working face of 54 feet, drilling being done by Cyclone Electric power drills. A large percentage of the output is used for fluxing purposes by the Steel Company of Canada, Hamilton. No additions were made to the plant during the year.

C. M. Doolittle is president and general manager, and J. B. Hart secretary-treasurer and assistant manager.

Christie-Henderson.—The Christie-Henderson quarry near Milton in the township of Nassagaweya, concession two, operated for the greater part of the year. The quarry is 700 feet long, and the working face is 40 feet in height, the stone being quite uniform in quality. Grey lime only is manufactured. Only sufficient force is employed to keep one kiln burning, with an output of 20 tons per day.

D. D. Christie, Guelph, is president of the company, and David Henderson, Acton, is associated with him in the ownership of the quarry.

Elora White Lime Company.—The quarry and hydrating plant operated by the above company near Elora, concession XII, township of Nichol, worked with increased output during 1917. Fifty tons of white lime per day is burned in the kilns and practically the whole of this output is hydrated.

The quarry has a working face of 25 feet, and during the year a Cyclone drilling rig was added to the quarry equipment, and the plant equipped with new hydrating machines.

The company is owned and managed by the Alabastine Company of Paris. J. Cameron is superintendent.

Hambleton.—The quarry owned by Robert Hambleton, near Hagersville, in the township of Oneida, operated for a short period during 1917. For the past two years, the quarry has been closed except for short periods during which the crushing plant was in operation supplying stone for country roads.

E. Harvey and Son.—The quarry owned by E. Harvey & Son, at Rockwood, near Guelph, operated for nine months during 1917. One kiln with a capacity of 20 tons of grey lime per day was in operation.

E. Harvey is manager, employing 15 men.

Interprovincial Brick Company.—This company was one of the few brick companies in the Province to operate continuously during 1917. The pressed brick plant, working with reduced capacity, has an output of 22,000 per day manufactured from the red shales and clays which occur throughout Halton county.

The quarry has a working face of 15 feet.

The officers are: A. O. Dawson, president, Montreal; E. G. Glenn, secretary, Toronto; F. B. McFarren, manager; K. Stillwaugh, superintendent.

The quarry and plant are situated at Cheltenham village, concession V, township of Chinguacousy, and the head office address is 30 Toronto Street, Toronto.

Michigan Central Quarry.—This quarry near Hagersville was in steady operation during 1917, the entire output being used by the Michigan Central railway for ballasting track. The quarry is worked in two benches with a total face of 20 feet. In 1917, fifteen miles of track in the vicinity of Hagersville were ballasted with material from this quarry. D. E. Cronin is superintendent for the railway company, and 65 men are employed.

Milton Pressed Brick Company.—This company is one of the largest manufacturers of pressed brick in the Province. Operations were carried on continuously during 1917, although the output was curtailed, due to scarcity of labour. Plant No. 2 in the township of Nassagaweya, near the town of Milton, formerly owned by the Toronto Brick Company, was closed during the year, but plant No. 1 operated steadily. From the mixture of clay and Medina shales found throughout this district the company make red and buff pressed brick, rough texture rug and wire-cut brick.

The officers are: J. S. McCannell, president; A. W. Holmsted, secretary; R. Wheeler, treasurer; C. E. Hill, superintendent.

Oneida Lime Company, Limited.—On the townline between Oneida and North Cayuga townships near the village of Nelles Corners, the Oneida Lime Company operates a quarry for the production of silica sand. The silica rock overlies the limestone in beds varying in thickness from 4 to 14 feet. The rock is crushed, ground and washed for shipment to the glass trade and ferro-silicon plants.

In April, 1918, the Canada Crushed Stone Corporation took over the quarry under lease, and operations are now under the direction of Mr. Doolittle.

In 1917, about 18,000 tons of silica sand were shipped from this quarry. Thirty-five men are employed.

Patterson Sand Company.—This company, successor to the Clifton Sand and Gravel Company, Stamford township, operated continuously during 1917. Robert Patterson is manager, employing about 12 men.

Building sand and gravel for concrete work are shipped from the old workings. During the past few years a large trade has been worked up in moulding and pipe sands. The moulding sand is shipped to all parts of Ontario and even as far east as Quebec, while a large trade in New York State is also supplied.

Queenston Quarry Company.—The limestone quarry owned and operated by this company is situated near St. Davids in the township of Niagara, lots 47, 48 and 49. During 1917, the crushing plant ran for three months only, and for the balance of the year building and dimension stone was shipped. The building stone plant is equipped with a set of gang saws and diamond saw, and blocks of large proportions are cut to required sizes.

The crushing plant consists of one No. 5 Austin gyratory crusher, followed by a Simons disc crusher and screening plant.

Charles Lowrey is president and manager of the company, and T. W. McKeown, secretary; 25 men are employed.

Robertson Quarry.—The quarry owned by D. Robertson & Co., Limited, lot 4, concession VII, township of Nassagaweya, operated continuously throughout the year. Work is being carried on in the extreme west end of the quarry, and the stone is hauled in carts to the kilns. Grey lime is manufactured, and only one kiln with a capacity of 20 tons per day is in operation.

D. Robertson, Milton, is president of the company, and J. R. Robertson, secretary.

F. Rogers and Company.—The quarry operated by this company is situated in Chinguacousy, on the east half of lot 30, concession VI, and the east half of lot 31, concession V. The chief production is in the form of flag stone, coursings and rubble stone. The quarry was worked during the summer months only because of slack demand in the building trade.

Dan Hastings is superintendent for the above company.

Standard White Lime Company.—This company, with headquarters at Guelph, operates quarries at Guelph, Beachville and St. Marys. White lime, high-grade fluxing stone, and hydrated lime are produced. At St. Marys, one kiln, with a

A blast at the quarry of the St. Marys Cement, Limited, resulting in 21,000 tons of broken limestone.

capacity of 25 tons of white lime per day, was in operation during seven months in 1917. The Guelph quarry and hydrating plant operated continuously with a working force of ten men. The principal operations of the company are carried on at Beachville, where two quarries are operated steadily. What is known as the West quarry produces stone for fluxing purposes, which is loaded directly into cars for shipment to Hamilton. This quarry has a working face of 25 feet. Stone from the East quarry is used in the kilns for the production of white lime. Two kilns, with a capacity of 20 tons per day, were in operation during the year.

The officers are: D. D. Christie, president; John Kennedy, manager; Wm. Culford, secretary-treasurer; W. P. Gamble, superintendent.

St. Marys Cement, Limited.—The quarry and cement plant owned by this company, formerly known as the St. Marys Portland Cement Company, was in steady operation during the year. By reason of power shortage the plant is now running at one-third capacity. Extensive additions to the crushing equipment were being installed in June, 1918. The No. 8 Kennedy crusher is being replaced by a 48 by 60-inch Blake jaw crusher, manufactured by the Taylor Engineering Company. This crusher has a capacity of 3,000 tons per day. Following the jaw crusher is a No. 7 Mammoth Williams hammer mill, manufactured by the Williams Patent Crusher and Pulverizer Company of St. Louis.

The officers of the company are: Geo. H. Gooderham, president; Hedley Shaw, vice-president; Mark Irish, secretary-treasurer; John G. Lind, manager.

St. Marys Horseshoe Quarry.—This quarry was operated for five months during 1917, the entire output being shipped to the National Portland Cement Company at Durham. Drilling is done by a power drill, the average hole being 40 feet deep, leaving a 4-foot bench at the bottom. The stone is crushed in a No. 6 Austin gyratory crusher, followed by a set of 22 in. by 24 in. rolls.

John Bonis is in charge of operations.

Toronto Lime Company.—The quarry owned by this company at Dolly Varden, concession IV, township of Esquesing, operated during the summer months of 1917. The stone is manufactured into grey lime, only one kiln being operated with a capacity of 15 tons per day. The quarry has a working face of 40 feet, and a much greater production could be maintained if trade were normal.

The Limehouse quarry and plant owned by this company were closed during the year.

The officers are: F. D. Brown, president; W. L. Scott, secretary-treasurer; W. Gowdy, superintendent; head office, 26 Queen Street East, Toronto.

Wentworth Quarry Company, Limited.—The quarry operated by this company is situated near Vinemount Station, T. H. & B. railway, on lot 4, concession V, township of Saltfleet. During 1917, operations were carried on continuously. The quarry has a working face of 19 feet, and drilling is done with a cyclone power drill. A set of Garfield rolls 12 in. by 16 in. has been added to the crushing plant.

F. W. Schwendiman is manager.

Gypsum

Ontario Gypsum Company, Limited.—This company is an amalgamation of the Crown Gypsum Company of Lythmore and the Alabastine Company of Caledonia.

The mine and grinding plant of the Crown Gypsum Company were not operated during the year. At the present time a shaft is being sunk beside the grinding plant at Lythmore to avoid the rail haul of 3½ miles from the old mine.

The Caledonia plant and mine operated continuously during the year, manufacturing hardwall plaster, plaster of Paris, Jand plaster and bug finish, supplying the markets of Ontario and Quebec, and shipping as far west as Winnipeg. The surplus is shipped to New York State.

The Carson mine is worked only during the winter months.

At the Caledonia mine the production is from the second, or 70-foot level, where the gypsum bed is about 6 ft. 6 in. in thickness. A third level, 14 feet below this, was opened up during the year, but this bed was only 4 feet thick. The production of this mine is about 200 tons daily.

W. C. Case, Buffalo, is president of the company; R. C. Haire, Paris, secretary-treasurer. The head office is at Paris and the works office at Caledonia. A. J. Parkhurst is general manager; about 75 men were employed on an average during the year.

VI.—Blast Furnaces and Refineries

Blast Furnaces

Algoma Steel Corporation.—The Algoma Steel Corporation has an authorized capital of 300,000 shares of a par value of $100 each. The officers of the company are: J. Frater Taylor, president; T. Gibson, secretary; J. Hawson, treasurer. These with the following constitute the board of directors: W. C. Franz, W. K. Whigham, H. Coppell and W. E. Stavert.

During the year 1917 a fourth blast furnace was installed; the No. 2 blast furnace of the Canada Iron Foundries, Limited, at Midland being purchased and re-erected at Steelton. This furnace has a capacity of 400 tons a day. The furnaces were operated continuously during 1917 as well as the Greenawalt sintering plant.

J. H. Bell is superintendent of blast furnaces, employing 300 men. V. H. Taylor is superintendent of the Greenawalt plant, employing 20 men.

Canadian Furnace Company.—The blast furnace of this company, situated at Port Colborne, operated continuously throughout the year with the exception of a ten-day shut-down due to coke shortage. Owing to the difficulties of securing a sufficient supply of coke, it was necessary to operate at a decreased production during part of the year.

The two large ore bridges were destroyed by wind-storms: No. 1 in October, 1917, and No. 2 in February, 1918; both are being rebuilt.

The officials of the company are: Frank B. Baird, president; Harry Yates, first vice-president and treasurer; C. A. Collins, second vice-president; F. C. Slee, secretary; B. Marron, manager; F. E. Deschenes, superintendent; D. J. Higgins, mechanical superintendent; 135 men were employed during the year.

The head office of the company is at 51 Hamburg Street, Buffalo, N.Y. The works office is at Port Colborne, Ont.

Steel Company of Canada.—Due to coke shortage, blast furnace "A" operated by this company at Hamilton was out of blast for 61 days during 1917. The larger furnace "B" operated continuously during the year. A large coking plant is in course of erection near the blast furnaces. One hundred and eighty-five men were employed in the blast furnace department.

Robert Hobson is president of the company; R. G. Wells, general superintendent; and Charles Grimes, superintendent of blast furnaces.

Standard Blast Furnace.—The blast furnace at Deseronto, owned by the Standard Iron Company, remained in blast throughout 1917. The Parry Sound furnace remained closed. Charcoal pig is produced at Deseronto, chiefly from Mesabi range ores, although some experiments have been carried on with a view to using Ontario magnetites.

The officers of the company are: R. J. Mercer, president; S. F. Belknap, secretary-treasurer; O. O. Laudig, works superintendent; 70 men were employed during the year. The head office of the company is at 318-321 Coristine Building, Montreal.

Tivani Steel.—The plant at Belleville owned by the Tivani Electric Steel Company was operated steadily during the year. The two electric furnaces, having a capacity of four tons each per day, and installed for the manufacture of tool steel, were used in the manufacture of ferro-molybdenum. At the beginning of 1918, owing to the scarcity of molybdenum concentrates, the manufacture of this product was discontinued, and the production of low phosphorus pig iron for munition work was undertaken. This has been successful. The charge consists of scrap—shell turnings—coke and lime.

Plans for a new 15-ton furnace, to replace the two small ones at present in use, have been drawn, and it is anticipated that this furnace will be in operation during 1918.

The officers of the company are: J. W. Evans, president; H. F. Ketcheson, vice-president; J. M. Wallace, manager; directors: R. J. Graham, H. Ackerman, H. F. Ketcheson, J. M. Wallace, J. W. Evans, J. A. McFee.

The capitalization of the company is $20,000, divided into 200 shares of $100 each, all issued.

Ten men were employed during the year.

Refineries

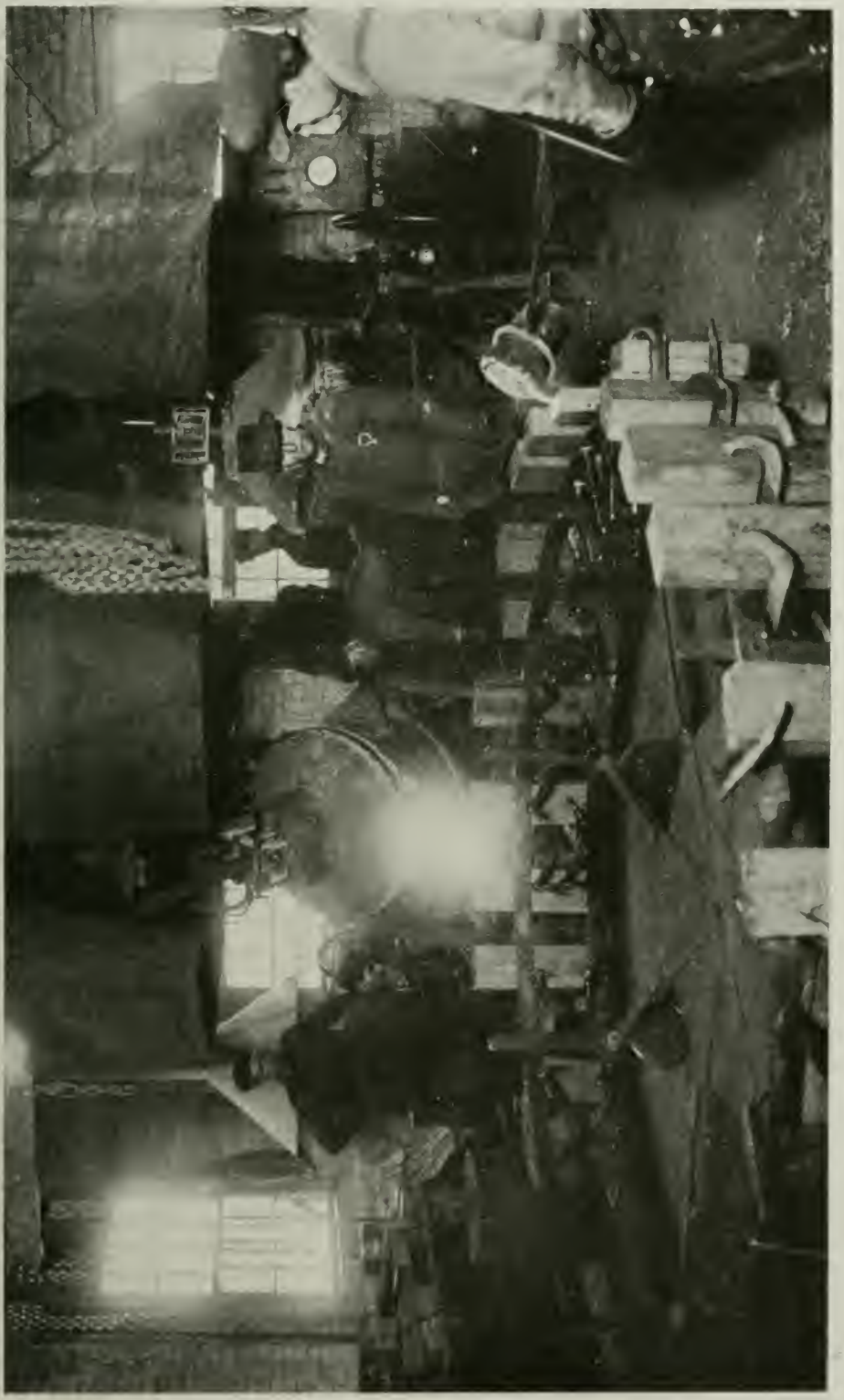
Coniagas Reduction Company.—This company operates a silver smelter and refinery at Thorold. The officials are: R. W. Leonard, president and general manager; R. L. Peek, superintendent; J. J. Mackan, secretary. The head office of the company is in St. Catharines.

In addition to treating the production of the Coniagas mine and concentration works, custom ores of the Cobalt district are purchased. The company produces cobalt oxide, nickel oxide, metallic cobalt, metallic nickel, white arsenic and bar silver electrically refined.

The additions to the plant during the year were a Cottrell installation in connection with the speiss roast furnace. This is a 96-pipe treater capable of handling 15,000 cubic feet of fumes per minute; a new bag house was built with a capacity of 20,000 cubic feet per minute, and a new transformer added to the power sub-station. About 150 men are employed.

Deloro Smelting and Refining Company, Limited.—The smelting and refining works of this company at Deloro, Hastings county, operated to full capacity during 1917. Various additions were made to the plant with a view of increasing

Pouring silver at the Deloro plant of the Deloro Smelting and Refining Company, Ltd.



Casting "stellite" at the Deloro plant of the Deloro Smelting and Refining Company, Limited.

the output of manufactured metals and of providing facilities for experimental work in the metals branch.

The company manufactures refined silver, metallic cobalt, cobalt oxide, metallic nickel, nickel oxide, refined arsenic and stellite. Metallic cobalt and nickel are supplied to the trade in the form of grain, cube, shot and ingot.

The output of stellite, the cobalt-chromium-tungsten alloy, was greatly increased during the year.

Additions to the plant included a new office building, bag house, metal building and warehouses.

The officers of the company are: M. J. O'Brien, president; Thomas Southworth, vice-president and managing director; S. B. Wright, general manager; S. F. Kirkpatrick, consulting metallurgist: F. A. Bapty, secretary-treasurer. Four hundred men were employed during the year.

Metals Chemical, Limited.—This company operate a refinery at Welland on residues purchased from the Cobalt mills.

Nickel oxides (grey and black), nickel carbonate, nickel sulphate, cobalt oxides (grey and black), cobalt sulphate, cobaltic hydrate, crude arsenic and bar silver are manufactured. About 60 men are employed.

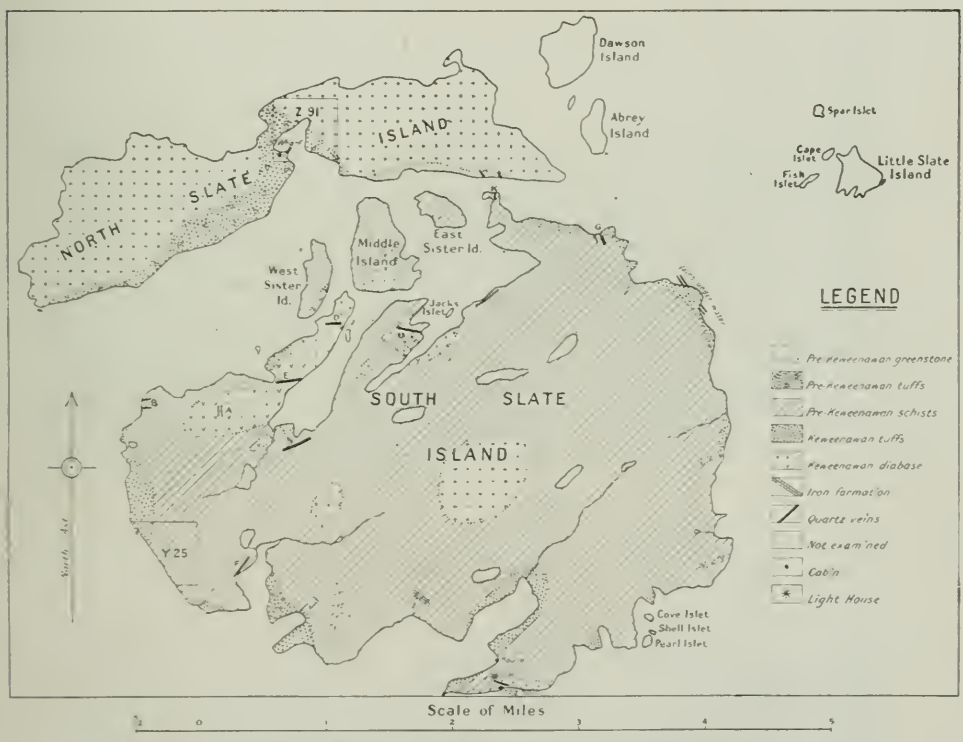
J. S. Gillies is president of the company and J. H. Charles, secretary-treasurer and general manager.

SLATE ISLANDS, LAKE SUPERIOR

By Arthur L. Parsons

Introduction

In view of the fact that several reports indicated that high-grade gold ore was to be found in considerable quantity on the Slate islands near Jackfish, the writer visited these islands twice during the summer of 1917 with a view of investigating the economic possibilities of the deposits. The first visit was solely



Geological sketch of Slate Islands, Lake Superior.

for the purpose of sampling the principal known veins, so that the later work might be carried out in a more intelligent manner. The second visit was made in the latter part of August and the first part of September, and comprised about two weeks' field work. At this time a more detailed study of the geology of the islands was made.

Considering the accessibility of these islands, remarkably little has been written concerning their geology; in fact, so far as the writer is aware, no attempt has been made to differentiate the various types of rock. This is less surprising when one sees the character of the rocks, for with few exceptions they are so decomposed and altered that it is extremely difficult to secure satisfactory specimens for study.

Location

The Slate islands consist of a group of some eight or ten islands located about seven miles south of the village of Jackfish on the north shore of Lake Superior. The total area covered by these islands is somewhere in the neighbourhood of 10,000 acres, of which about 2,000 acres are in North island and 7,000 acres in South island.

At the present time the islands are totally uninhabited except by the keeper of the lighthouse on the south side of South island, though some years ago there were mining camps at several locations on the islands.

Fig. 1—Rugged shore, South Slate island.

Fig. 2—Southwest point of South Slate island, showing shoals.

A few years ago fire swept over a large portion of South island, so that the rugged character of the country is emphasized. On the unburned portion of this island as well as upon North island there is a good growth of the ordinary forest trees of this region, including spruce, balsam, Banksian pine, birch and poplar and some red pine.

Topography

The shore line of the islands is extremely rugged (fig. 1) and to a large extent precipitous, but in most cases no idea of the depth of the water at the base of the cliffs can be obtained, as is so frequently the case in regions where Keewatin rocks are prominent. Very frequently there is a broad irregular shelf of rock a few feet beneath the water's surface, and sometimes protruding above the water (fig. 2), so that it is extremely dangerous to try to keep near the shore in a boat except in calm weather. The rock has been much eroded by wave action, hence the shore is very similar to that in the Keweenawan rocks at Maimanse.

Fig. 3—Volcanic neck, South Slate island.

Fig. 4—Weathered diabase dike, South Slate island.

The surface of the islands is possibly not so rugged as might be expected in view of the character of the shores, yet on going to the highest peak of South island eight lakes were seen, while several others were found which are invisible from this point. Several of these lakes, possibly all of them, appear to be crater lakes, while the highest point on the island seems to be an old volcanic neck (fig. 3). Another similar volcanic neck is found near the northwest

point of South island. Dikes are frequent, and are often partially decomposed, leaving jagged peaks protruding above the ground level (figs. 4 and 5). The lighthouse is located upon the highest point of one of these dikes (fig. 6).

Geology

In general it may be said that there are two great epochs of rock formation represented on South island, though both appear to be volcanic. The rocks vary from the coarsest volcanic tuff to the most compact igneous rock. The older series appears to have been similar to the later one, but has been subjected to pressure so that schistosity has developed to a large degree. The remarkable variation in the character of the rocks presents a most complex problem in mapping, and it is only when the highest point of the island is reached that a possible solution of the difficulty is presented. This highest point (fig. 3), which is about 250 feet above the level of Lake Superior, is a roughly circular mass of diabase protruding through the surrounding schists and apparently is an old volcanic neck.

From its summit numerous lakes filling depressions which are possibly old craters are to be seen. Many of these, if not all, are surrounded by rock rims (figs. 7, 8 and 9). This volcanic neck suggests the probability that all the rocks on the island are of igneous origin, and the problem is to differentiate various volcanic flows. This can be done only in a very imperfect manner.

On North island the rocks are similar in type to those on South island, including grayish diorites and tuffs, but little if any schistosity has developed. In appearance these rocks are similar to the Keewatin greenstones and tuffs, and probably represent an older volcanic series than the mottled tuffs of South island. On the south side of the island some of the rock is schistose and is probably to be correlated with the schists of South island.

Exact correlation of these rocks with formations elsewhere is impossible, but from resemblances to other rocks and stratigraphic relations observed the following general order of formation is given:

Keweenawan: Diabase—volcanic necks and dikes.
Tuffs.
Pre-Keweenawan: Greenstones.
Tuffs.
Sericite Schists.

Keweenawan

Keweenawan Tuffs.—Near the shore of South island, but more particularly on the east, south and west sides, there are numerous outcrops of tuffs which are usually of mottled red and green colours. In some instances the fragments composing these tuffs are of enormous size (fig. 10) and the rock appears to be a conglomerate. Several of the pebbles were extracted from a decomposed mass of this type of rock, and in no case did they show signs of either water or glacial action, moreover, the fragments were all of one type of rock and although roughly angular showed a certain rounding of the corners that eliminated the possibility of the rock being a breccia. In most cases, however, the tufaceous character of the

deposits was remarkably distinct. These tuffs in all probability at one time overlay a considerable portion of South island, and at certain places on the west side of the island they are to be seen overlying the older schists on some of the high hills. At present, however, little trace of the later tuffs is visible except near the present shore line. It seems probable that much of the tuff has been removed by wave action at the time when some of the great gravel deposits along the north shore of Lake Superior were formed. This theory is further strengthened by the

Fig. 5—Diabase dike, showing jagged peaks due to weathering.

Fig. 6—Reef in front of Slate island lighthouse.

finding of large accumulations of worn pebbles of some of the more resistant rock of the island in some of the valleys above the present lake level.

Keweenawan Diabase.—The latest rock on the island is found in dikes and roughly circular masses which have every evidence of being volcanic necks. Whether these necks represent a molten mass which slowly cooled in the volcano or was extruded in a solid condition is a problem that is difficult to solve. In modern times the only recorded example of the latter type of volcanic eruption is the remarkable spine of Mt. Pelee, and in that case it is probably too soon to observe

certain phenomena that have an important bearing in the case under consideration. In certain instances the older rocks at some distance from the diabase are only slightly altered, and are principally granodiorites and diorites of a red or grey colour. These unaltered portions are, however, of very limited extent and near the shore where the less resistant altered material has been removed. In contact with the diabase the older rock is highly schistose, and nearly the whole mass of the older formation on South island is of this schistose character. Apparently

Fig. 7—View from Beacon, showing two lakes and bay.

Fig. 8—View from Beacon, showing four lakes.

this schistosity has been developed by the volcanic necks and dikes either from the pressure exerted by a mass of rock in cooling or by the pressure of a mass that was extruded in the solid condition. Where contacts were seen there is no particular evidence of thermal metamorphism such as is found in connection with the great dikes in the Lake of the Woods. The absence of the evidence of thermal metamorphism must be looked upon as presumptive evidence that the diabase was extruded at a temperature near the point at which it would solidify, so that

little heat was transferred to the adjoining rocks. The extraordinary shattering of the older rocks bespeaks a source of pressure not shown in the vicinity of dikes that have come under the writer's observation. In similar manner the same evidence of pressure is lacking in the few comparatively modern volcanoes which it has been his privilege to see.

In composition the diabase is of a normal type consisting of labradorite and augite, with a small quantity of ilmenite and possibly magnetite.

Pre-Keweenawan

Pre-Keweenawan Schists.—The main portion of South island and a part of the south shore of North island is composed of a schist which varies from a grey to cream-coloured sericite schist. In only a very few places is any trace of the original rock evident, but where seen, it is a diorite or a quartz diorite. Un-

Fig. 9—Crater lake, west side of South Slate island.

doubtedly these schists gave the name to the islands, for although the rock is unlike slate in most respects, it has one of the most striking features of a slate in its easy separation into thin sheets. These schists are cut by the Keweenawan dikes and volcanic necks, but underlie all the other rocks.

Pre-Keweenawan Greenstones.—North island consists for the greater part of a greenish grey diorite, which in places exhibits pillow structure but more commonly is massive. In appearance and character of occurrence this rock resembles the Keewatin greenstones. In general the shore line is precipitous, and, unlike the shore of the south island, deep water is found even close to the shore. From a stratigraphic point of view it is not possible to assign a definite age to this rock, though it overlies the pre-Keweenawan schists which are so prominent on South island.

Pre-Keweenawan Tuffs.—Associated with the greenstones of North island is a considerable area covered by tuffs and breccias, which are petrologically similar to the greenstones. Near Copper Harbour on the south side of the island, these tuffs are cut by a diabase dike so that they are older than the latest rocks of the islands.

Iron Formation

Iron Formation.—On the northwest point of South island is a brecciated banded quartz rock (fig. 11) which resembles banded Iron formation. This is on the shore near the old tunnels which were driven on two veins for gold. In the more northerly of these veins a small quantity of jaspilyte was found accompanying the vein quartz, but a definite connection between this and the brecciated

Fig. 10—Tuff on east side of South Slate island.

rock was not established. In the case of the jaspilyte it was undoubtedly introduced after the development of schistosity in the rock, and is similar to the jaspilyte associated with crystallized hematite and vein quartz in small veins near Maimanse. A second outcrop of Iron formation is found south of the large volcanic neck near the south shore of South island. Neither of these outcrops, however, is of economic importance.

Age of Veins.—With but two exceptions, the quartz veins observed are situated either in the pre-Keweenawan schists or in the Keweenawan diabase. So far as those in the diabase are concerned, they must of necessity be referred to the Keweenawan or to a later period. Those in the schist are in most if not all cases to be referred to the period when schistosity was developed at the time of the

formation of the volcanic necks and dikes, the age of these veins in the schist being the same as that of the veins in the dikes. On North island two small veins were observed in the pre-Keweenawan greenstones and tuffs. For these it is not possible to definitely assign the same age, but as they are not far from outcrops of the older schist it seems reasonable to suppose that they belong to the same series of veins.

Fig. 11—Brecciated iron formation, South Slate island.

Economic Geology

Copper

On North island some years ago a prospecting tunnel was opened up on the shore of Copper Harbour, evidently with the idea of developing a copper prospect. No information concerning operations is available, and no trace of copper-bearing rock was observed by the writer. The rock through which the tunnel was driven is a volcanic tuff which might possibly carry copper, and it is probable that specks of copper were found to justify the development work, but as the property has been abandoned it would appear that no deposit of economic promise was encountered.

Iron

In former reports mention has been made of Iron formation and iron ore as float. Iron formation was observed in two places, but under conditions that appear to be connected with vein formation. No trace of workable deposits is evident.

Gold

On both the large islands, but more particularly on South island, there is a remarkable development of quartz veins which contain a greater or less quantity

Fig. 12—Old tunnel, northwest point of South Slate island.

of gold. Prospecting work has been done on several of these. In some of the veins rich specimens have been obtained, but so far nothing that would warrant the expenditure of any large sum of money has been found. Probably the richest vein on South island is located on the west side of St. Mary's bay. The various veins are indicated on the accompanying map by letters, and the description of the individual veins follows. All the assays were made by W. K. McNeill, Provincial Assayer.

A veins.—At the point marked A are two small veins just to the west of the high diabase knoll. These are about 8 feet apart, and are 8 inches and 5 inches wide respectively. They strike nearly north-south, and are therefore distinct from veins E and B which have been supposed to be continuous. No trace of a vein was found that would warrant such a supposition. Neither of these veins yielded either gold or silver.

B vein.—At the point marked B are two tunnels, the more northerly of which (fig. 12) is of interest, though the assays of the samples were disappointing. The vein is about 8 feet wide, and consists of white quartz on the south side, red jaspilyte on the north side, and rusty quartz in the centre. The vein is consider-

Fig. 13—E vein, South Slate island.

ably brecciated and is between schist walls. The principal interest in this vein lies in the jaspilyte associated with the vein quartz, which is suggestive in connection with the origin of certain iron deposits.

About 400 feet south of this tunnel is a second one beside a vein about 4 feet wide. In the roof of the tunnel several quartz stringers were visible, but none of these were an inch in width. The samples taken for assay from these veins carried no gold or silver, though the brecciated rock shown in fig. 11 yielded 40 cents in gold per ton.

D vein.—At D is a vein which varies from 4 to 8 feet in width. The quartz is well mineralized and shows some rusty weathering. The sample for assay was taken from a section 4 feet wide and included one foot of wall rock. On assay no gold was found.

E vein.—The largest vein observed is at the point marked E. It consists of white quartz in diabase, and is about eighteen feet wide (fig. 13). This was sampled twice the full width of the vein, but the results of the assays were negative.

F vein.—On the west side of St. Mary's bay is a vein with a width varying from 4 inches to 8 inches. In this vein visible gold was found, and samples the entire width of the vein were taken for assay. It is believed that these samples represent the maximum value that can be expected from any quantity of ore that might be mined from this vein. Selected samples might be taken which would yield much greater values. The quartz is white and milky, and the length as shown by numerous test pits is not less than 400 feet. Three samples were taken for assay, yielding $15.40, $0.00 and $3.20 per ton.

Fig. 14—Lighthouse veins, South Slate island.

G veins.—At the point marked G are two veins about 50 feet apart, the easterly one being 15 inches wide, the westerly one 2 inches. These were exposed on the rocky shore, but were not traced inland. No traces of old workings were found, though there is a record of work having been done. The larger vein gave on assay $1.60 and $2.40 per ton, while the smaller one yielded $2.60 per ton.

K vein.—At the point marked K on South island is a vein about 6 feet wide of rather bluish quartz, upon which several test pits had been sunk. In only one of these was it possible to see the vein material, but in this one the entire width of the vein was exposed. Private reports made to the former owner of the property indicate that this vein extends under water to North island. There is, how-

ever, at present no vein visible on North island that is of sufficient size to warrant the expenditure of much time or money in its development. Two samples were taken for assay, neither of which contained gold or silver. Samples were also taken from small veins on North island near this point, but in no case was gold or silver found.

Lighthouse veins.—Probably the most striking exposure of quartz veins on the islands is on the face of the cliff just below the lighthouse (fig. 14). At this point the vein system appears to consist of at least six distinct veins, though at a point possibly 600 feet east there is only one visible. The greatest width measured is 7 feet. Five samples were taken from various points for assay. One of these showed a trace of gold, the others nil.

N vein.—At N is a vein about 12 feet wide, though the walls are not well defined on the surface. This vein is nearly parallel with the southeast shore of the bay, and strikes approximately northeast-southwest. The sample yielded no gold.

O vein.—At the point marked O are some old test pits from which considerable quartz had been removed. The width of the vein could not be seen in these pits, but from the size of the material on the dumps it is at least a foot wide. One vein 4 inches wide was observed at this place. Two samples were taken, both of which were free from gold or silver.

MINERAL DEVELOPMENTS IN N.W. ONTARIO

By Arthur L. Parsons

Introduction

In accordance with instructions from T. W. Gibson, Deputy Minister of Mines, the writer devoted the greater part of the past summer to the examination of mineral deposits in western Ontario which were reported to be of prospective value in furnishing materials important for munitions.

The materials which received particular attention were copper, iron and pyrite. With few exceptions, deposits upon which development work was not in progress were not visited, though in certain cases where it was thought that valuable information could be secured such examination as was feasible was made. In addition to the above mentioned materials, samples were taken from two places on the Lake of the Woods for platinum assay with negative results.

On account of the nature of the work and the scarcity of help, it was necessary to depend largely on assistance that was cheerfully given by those interested in the properties examined. In particular the writer wishes to express his appreciation to Dr. W. L. Goodwin, Principal of the Kingston School of Mining, Col. S. W. Ray, of Port Arthur, and Dr. Warren Smith, Mokomon, Ontario, for assistance rendered not only by themselves but by those in their employ.

Copper Deposits

Owing to the high price of nearly every metallic product, the attention of prospectors and investors has been turned to the consideration of deposits which under ordinary conditions would not be considered of economic value. In several instances extensive low-grade bodies have been discovered, some of which will probably be worked long after the present stress is relieved. Among these products copper is most eagerly sought, and on account of the probability of the ore carrying values in gold and platinum, the probability of a stable foundation for the copper mining industry seems better than for most other metals. An important factor tending to retard the development of all but high-grade deposits, is the lack of a smelter or matting plant conveniently located with respect to known deposits in western Ontario, the consequence of which is that an unreasonable proportion of the returns for ore must be paid for freight charges.

During the past year copper ores have been shipped from two mines in western Ontario; the Tip Top near Kashaboiwe, and the Port Arthur Mining Company's at Mine Centre. In addition, considerable prospecting and development work has been done on properties near Lake Shebandowan and Mine Centre with more or less success.

The most extensive development is at the Tip Top mine, where a narrow gauge railway six miles in length has been built to haul the ore to the Canadian Northern railway two miles west of Kashaboiwe station.

Though the properties have many points in common, there is not sufficient information available at present to give a general description, hence each deposit is described separately. From the character of certain rocks at the Tip Top mine and from the geological relations of some of the copper-bearing rocks near Mine Centre, it would appear that there is an intimate relation between the copper ores and the Iron formation.

Fig. 1—Shaft house and sorting platform, Tip Top mine.

Fig. 2—Round house, Tip Top mine.

Tip Top Copper Mine

This mine is located near Round lake, and is sunk on a deposit of chalcopyrite and pyrite at the contact of Keewatin greenstone and sericite schist. Associated with the ore body and forming part of the sericite schist, is a large quantity of quartzose rock containing bluish quartz very similar to the quartz associated with the gold ores of the Laurentian, Ophir and St. Anthony mines. The main shaft has been sunk about 200 feet, and four levels have been opened. Only the first two were pumped out at the time of the writer's visit. On each of these levels two stopes have been opened, making 4,000 tons of ore available for mining. The principal vein is about 12 feet wide. The assay plan of the mine shows an ore chute about 150 feet long extending below the third level, but not yet proven on the fourth level. An examination of the drifts and stopes that could be inspected shows at least the quantity of ore above mentioned, but it does not appear to be definitely proven that the ore values cut off as indicated in the assay plan, since the main drift appears to leave the ore body to one side.

Fig. 3—Ore trestle, Tip Top mine.

A second vein about eight feet wide is found near the east end of the second level. This consists principally of pyrite, and is probably to be correlated with a rusty outcrop on the surface near the blacksmith shop.

Shipping was suspended at the time of the first visit in June, owing to the necessity of ballasting the narrow gauge railroad which connects the mine with the Canadian Northern railway. This railroad was constructed in the winter, and with the advent of spring a large force of men was employed in putting the track in shape so that shipments could be continued.

Since Dr. E. S. Moore's report[1] on this property there has been little change in the buildings and equipment except in connection with this railway. A new loading and sorting platform (fig. 1) has been erected at the mine to facilitate handling the ore and waste rock. This is of sufficient size to permit six 10-ton

[1] 20th Rep. Bur. Min., 1911, Pt. 1, pp. 210-13.

cars to be loaded before shifting. A building for storing the two small locomotives (fig. 2) has been erected near by. At the Canadian Northern railway a loading platform has been erected to facilitate the transfer of the ore from the narrow gauge cars to those of standard gauge (fig. 3).

Hoisting operations were recommenced on June 22, and continued during the summer, though much of the ore shipped was obtained from the old stock pile.

Fig. 4—Boarding camp, Tip Top mine.

Fig. 5—Manager's house, Tip Top mine.

In addition to the main shaft, three other shafts have been sunk to prospect the property, and considerable trenching has been done. The best showing obtained in this way is near No. 3 shaft. Good ore was taken from this shaft, which is at the side of a valley about 50 feet wide. Several trenches have been opened up in this valley, and in nearly every case gossan and chalcopyrite were found. In one trench considerable ore was taken out, possibly three or four tons, and

Fig. 6—Assay office and hoist house, Tip Top mine.

Fig. 7—Transporting men and provisions to Tip Top mine.

the indications point to a second ore body even larger than that upon which the most work has been done. This has been further confirmed by diamond drilling, and the writer was informed by the manager, Mr. Stewart, that about 25 feet of good ore was found in this way. So far as the writer could judge, this body of ore is distinct from the one upon which mining operations have been carried on.

Little can be added from a geological point of view to Mr. Moore's map, though the greenstone was found to have a slightly greater extent than was indicated by his work.

The boarding camp (fig. 4) is located about a mile from the mine on the shore of Round lake, and is unusually clean and well kept. From the point of view of convenience it would be preferable to have it located nearer the mine, but a supply of good water is a factor that offsets to a great degree the inconvenience due to the greater distance.

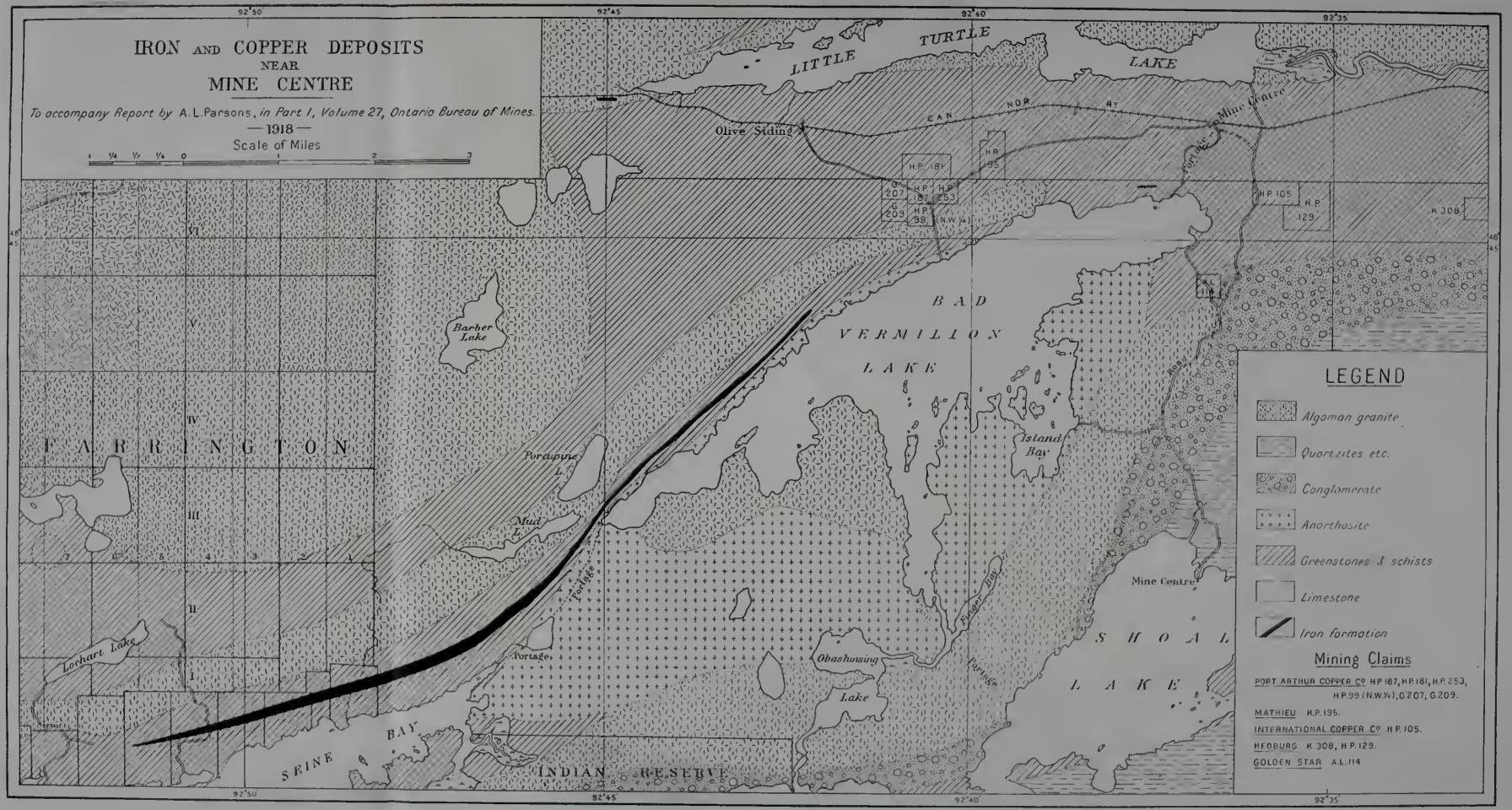
Prospects near Mine Centre

The copper deposits in the vicinity of Mine Centre are principally associated with schistose rocks which are for the most part altered representatives of the greenstones and anorthosites of the region. These are discussed in greater detail

Fig. 8—Open pit and shaft opening, Port Arthur Copper Co., Mine Centre.

in connection with the description of the Mine Centre iron deposits. The location of the various properties upon which prospecting was carried on is shown in the map accompanying this report.

Port Arthur Copper Company, Limited.—On H. P. 187 a rather remarkable deposit of copper ore was opened in the winter of 1916-17, and several carloads of ore were shipped for treatment to the smelter at Trail, B.C. From information given by W. H. Connell, manager of the company, the copper content of the shipments ranged from 3 to 3.5 per cent. The early work at this property consisted of open-cut mining entirely, the nature of which is indicated in the accompanying view of part of the workings. When the writer reached Mine Centre, work had been discontinued during a reorganization of the company, but before leaving the work was again resumed, and a shaft which shows at the right of the bucket in the picture (fig. 8) had been sunk to a depth of 10 feet with a few days'


IRON AND COPPER DEPOSITS
NEAR
MINE CENTRE
To accompany Report by A. L. Parsons, in Part I, Volume 27, Ontario Bureau of Mines.
— 1918 —
Scale of Miles
92°50'
92°45'
92°40'
92°35'
LITTLE TURTLE LAKE
CAN NOR RY
Olive Siding
Mine Centre
H.P. 181
H.P. 195
H.P. 253
H.P. 99 (N.W.¼)
H.P. 105
H.P. 129
K 308
BAD VERMILION LAKE
Barber Lake
Porcupine L.
Mud L.
Portage
Island Bay
Mine Centre
Pelican Bay
SHOAL LAKE
Obashinsing Lake
Lochart Lake
SEINE BAY
INDIAN RESERVE
FARRINGTON
I
II
III
IV
V
VI
LEGEND
Algoman granite
Quartzites etc.
Conglomerate
Anorthosite
Greenstones & schists
Limestone
Iron formation
Mining Claims
PORT ARTHUR COPPER Co H.P. 187, H.P. 181, H.P. 253, H.P. 99 (N.W.¼), G. 207, G. 209.
MATHIEU H.P. 195.
INTERNATIONAL COPPER Co H.P. 105.
HEDBURG K 308, H.P. 129.
GOLDEN STAR A.L. 114

Little can be add
though the greenstone
indicated by his work.

The boarding cam
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view of convenience it
but a supply of good v
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The copper deposit
with schistose rocks wl
greenstones and anorthc

Fig. 8—Open pit

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map accompanying this

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shipments ranged from
of open-cut mining enti
view of part of the wo
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the work was again res
in the picture (fig. 8)

work. It was the intention to sink this shaft to a depth of 200 feet before resuming the shipment of ore.

In some respects the deposit is remarkable, as there are scarcely any surface indications of a deposit containing iron or copper. The rock appears for the most part to be a sericite schist which preserves to some extent the traces of an amygdaloidal structure in the rock from which the schist was derived (fig. 9). Little if any gossan or copper stain was observed, but a trench which had been cut across the deposit showed that this schist is highly mineralized with sulphides including pyrite, pyrrhotite and chalcopyrite. This mineralization extends almost to the surface of the rock, so that the absence of weathering products is decidedly remarkable.

The mineralized zone is about 75 feet wide, with the greatest concentration in a width of about 15 feet.

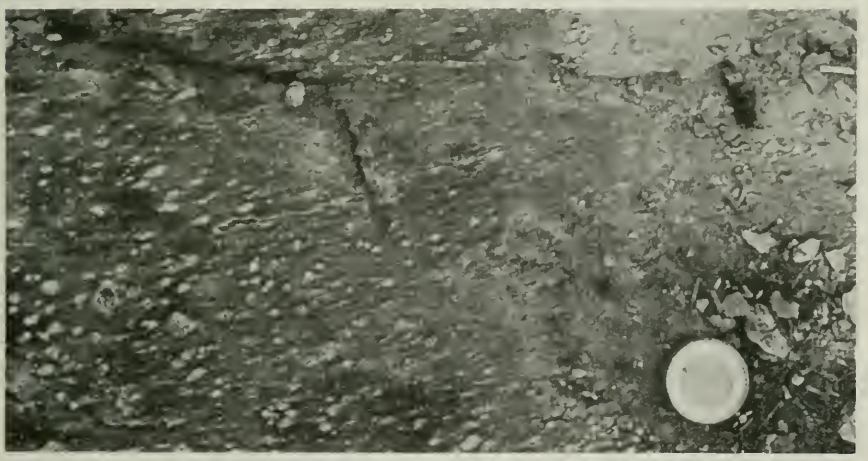


Fig. 9—Schistose amygdaloid, Port Arthur Copper Co's. mine.

The impregnation of this rock appears to have been coincident with or slightly later than the quartz which lines some of the amygdules. Many of the amygdules contain both quartz and sulphides, and in this respect are analogous to the black schist in Ptarmigan bay of Lake of the Woods, which was described by the writer in an earlier report.

During the winter of 1917-18 the shaft was sunk to a depth of 100 feet, and the first level was opened up by a drift which is reported to be about 200 feet long. It is reported that the ore is fully as good at this depth as on the surface, and it is expected that the shaft will be sunk another hundred feet to prove up a further reserve of ore.

This company also holds the following claims: H. P. 181; H. P. 295; G. 207; G. 209 and the N. W. 1/4 of H. P. 99.

J. A. Mathieu's Property.—About two miles southwest of Mine Centre, overlooking Bad Vermilion lake, J. A. Mathieu, M.P.P., of Fort Frances erected camps and sank two test shafts during the winter and spring of 1917. Work

was discontinued about the first of July, and no one was on the property when the writer made his visit. The rock is similar to that on the property of the Port Arthur Copper Mining Company, being a sericite schist which is somewhat mineralized with pyrite and chalcopyrite. Some traces of malachite and azurite were observed on the dump, but the copper-bearing minerals were not particularly abundant. The accompanying view (fig. 10) shows the camps and one of the shafts.

Samson Walker's Claims.—About three-fourths of a mile east of Mine Centre. Samson Walker had a few men employed in sinking test pits in a somewhat

Fig. 10—Shaft and camps, Mathieu's claim.

brecciated schist. Although slightly mineralized, the deposits so far as developed do not appear to be valuable for copper.

Golden Star.—On the old Golden Star mining property two openings were made prior to the writer's visit on bodies of copper ore. In both cases the ore consisted of a mixture of chalcopyrite and pyrrhotite, and in many respects resembles the Sudbury nickel ore. The deposits are located in the greenstone and schists of Keewatin age, and in some portions exhibit a banding similar to that shown by the Keewatin Iron formation. In fact, it is probable that we have here a phase of the Iron formation similar to that shown on the west shore

of the lake, where it grades into a banded rock containing a greater or less quantity of chalcopyrite and other sulphides.

H. H. Wood was engaged in getting out a carload of copper ore, and later in the year made a shipment. At the time of the writer's visit the work was all confined to two open cuts, from 6 to 10 feet wide, the larger of which was about 30 feet long and 10 feet deep at the face of the working.

Laurence Hedburg's Claims.—About two miles east of Mine Centre, Laurence Hedburg was developing copper deposits on two claims, K 308 and H. P. 129.

On the first of these claims the ore consists of chalcopyrite associated with quartz interbanded with schist, forming a great fahlband. Some of the quartz bands are as much as 10 feet wide, and contain some siderite in addition to chalcopyrite and pyrite. The samples taken from this property are some of the

Fig. 11—Drill on H. P. 105, Mine Centre.

most attractive seen by the writer. These high-grade samples come principally from a band about a foot wide which would probably average more than 20 per cent. chalcopyrite in bulk. The claim should be further prospected.

On H. P. 129 Mr. Hedburg had just started work on a schistose amygdaloid which carries some chalcopyrite and some free gold. The writer found some visible gold in a small quartz vein about one inch wide which crosses the schist. At the time of the writer's visit the deposit was not sufficiently developed to enable an estimate of its economic possibilities to be formed. The ordinary rusty outcrop which is so common on deposits of sulphide ores is not prominent here. In this respect it is analogous to the deposits of the Port Arthur Mining Co. which were remarkably free from gossan.

Before an estimate of the value of the property can be made further development will be necessary. The almost complete absence of gossan makes prospecting exceedingly difficult, but it will be well to investigate the amygdaloidal rocks of this vicinity for further deposits of copper-bearing minerals.

International Copper Mining Co.—Under the name of the International Copper Mining Company, Messrs. Kennedy, Riley, Osborn and other gentlemen from Beaudette, Minnesota, were engaged in the development of a copper property on H. P. 105. This claim has been re-surveyed, and is now known as F. F. 387 and 388. A test pit had been sunk in a sericite schist which carried some chalcopyrite, and in some of the fissures erythrite or cobalt bloom was present. At the time of the writer's visit a diamond drill (fig. 11) was being used in the attempt to locate a body of richer ore than was found on the surface. The presence of erythrite gives encouragement to prospect further, since this is so commonly associated with silver ores. It is, however, an unusual mineral in association with copper ores, though in some of the Cobalt mines sulphides of copper have been found. Although considerable work had been done, a deposit that could be worked profitably had not been developed at the time of the writer's visit.

Lake Shebandowan Deposits

Having been informed that work had been done in developing copper and nickel deposits on lake Shebandowan, the writer attempted to find the workings, but as the nickel property was not on the lake shore and the boatman did not know where it was, it was impossible to locate it in the time at the writer's disposal. A small deposit of pyrrhotite not far from the location was seen, but the owner who was met later in Port Arthur confirmed the writer's opinion that this particular outcrop was not of economic importance.

About a mile east of the old Dawson road on the north shore of the lake, is an open cut partially filled with water, from which attractive specimens of azurite and malachite were taken. The work had apparently been abandoned for some time, and an examination of the dump failed to show any quantity of ore.

Mine Centre Iron Deposits

The principal deposits of iron in the vicinity of Mine Centre consist of titaniferous magnetite in which a certain percentage of vanadium is found. It was suggested by Dr. W. L. Goodwin, who was supervising the drilling of a considerable portion of the range, that it should be called the Fetiva range, thus indicating by the name the three prominent elements in the ore, iron (Fe) titanium (Ti) and vanadium (V).

Location

Extending along the northwestern shore of Bad Vermilion lake from a point about two miles from Mine Centre station on the Canadian Northern railway, is a precipitous cliff in which are located two or more parallel deposits of iron ore. By the use of the dip needle and magnetometer, as well as by the finding of outcrops, these deposits have been traced across the rolling country intervening between Bad Vermilion lake and Seine bay of Rainy lake, and thence along the north shore of Seine bay. The limit of the deposit on Seine bay was not observed by the writer, but he was credibly informed that at least one of the deposits outcrops near the mouth of the bay, giving a body of ore from 12 to 15 miles long.

Transportation

These iron deposits are at present reached in the summer by canoe or by a trip through the woods from Mine Centre. Part of the distance can be covered by a wagon road, and in conveying heavy supplies it would be necessary to extend this road. For actual mining operations, however, it would be necessary to put in a siding either from Mine Centre or Olive siding, so as to provide for the shipment of ore. Such a siding would involve the construction of four to six miles of track to reach the deposits that with present development appear to be the most promising. With further development, this could be extended parallel with the strike of the deposit so as to permit of working the deposit in several places.

Fig. 12—Outcrop of iron ore near Bad Vermilion lake.

Geology

The geology of the area covered by these iron deposits as well as the greater part of the Mine Centre copper deposits has been studied on two occasions by A. C. Lawson.[1] Unfortunately, that portion of the country to the northwest of Bad Vermilion lake was completely burned over a year or so ago, destroying large quantities of valuable timber. While this fire was a calamity so far as the loss of timber is concerned, it has given an opportunity of studying the geology that was not available when Dr. Lawson examined the region. The new information is incorporated in the accompanying map, which is based principally on Lawson's second one.

[1] G. S. C., Vol. III, N.S., 1887-8, Pt. I, Sec. F., Report on the Geology of the Rainy Lake Region; also G. S. C., memoir No. 40, The Archean Geology of Rainy Lake Re-studied, 1913.

The most important alteration in the mapping is in connection with the granite, practically all of which is referred by the writer to the Algoman rather than to the Laurentian. This change is due to the contact relations shown at the Golden Star mine between the granite and the Seine conglomerate. At this place the conglomerate has been metamorphosed by the granite, so that there is a narrow band of schist at the contact of the two retaining the outlines of the pebbles of the conglomerate, though in other respects similar to the sericite schists in this and other pre-Cambrian regions. Another feature connected with this metamorphism, is an apparent impregnation of the conglomerate with a certain amount of the granite. This feature is discussed at greater length in the description of the Seine conglomerate. A similar feature was noted near the contact of the granite and the anorthosite areas. In certain cases the anorthosite was impregnated with quartz near the contact with the granite, so that it was not always easy to find the contact between the two.

The geological succession of the formations found in the area covered in this report and the descriptions of the copper deposits is as follows:

Granite and Granite Gneiss		Algoman.
Quartzite and Slate Conglomerate	}	Seine Series—Huronian.
Anorthosite Greenstones	}	Keewatin.

Algoman

Algoman Granite.—The Algoman granites have been most excellently described by Lawson, so that only a brief description will be necessary in this report. Formerly these granites were referred to the Laurentian, and it is only by observing the contact relationships that it is possible to assign a definite age to the great granite masses. Probably the best that can be done in most cases is to say that it is not later than a certain period.

The granites most closely observed were those around Bad Vermilion lake which are light in colour and moderately coarse grained. Dark minerals and sulphides are almost lacking, and the rock consists principally of quartz and plagioclase feldspar. Strictly speaking, therefore, it can hardly be called a granite, but approaches the quartz diorites. In places the feldspar has been partially altered to sericite, and at the contact of this rock with the overlying Seine conglomerate, molybdenite was found to which it is difficult to assign any other origin than the granite. The quartz in the granite has a peculiar bluish tint, but when observed in the rock in the field the mass appears to have a pale cream colour. This is possibly due to the presence of sericite which has resulted from the alteration of the feldspar.

Keewatin

Keewatin.—The Keewatin rocks of the area are of two general types, both of which have suffered alteration in certain places, giving rise to schists and para-gneisses whose origin is sometimes difficult to trace. These two principal types are anorthosite and greenstone, the latter being in some instances a more basic marginal phase of the former.

The main anorthosite mass is somewhat elliptical in form, and is roughly bounded by later granite masses. Along the southern border of the anorthosite no trace of a basic margin was observed, but occasionally quartz was found. At first it was thought that this indicated a crystallization of quartz from the molten anorthosite, but the impregnation of the Seine conglomerate at the Golden Star mine by granite, and the consequent enrichment of this rock in quartz, leads to the conclusion that the quartz present in the marginal phase of the anorthosite is due to the action of the later granite. On the northern edge of the anorthosite the rock becomes more basic and finally grades into an iron ore, but there is a less basic band as the northern granite is approached, and an enrichment with quartz similar to that seen on the southern edge. In the midst of the anorthosite

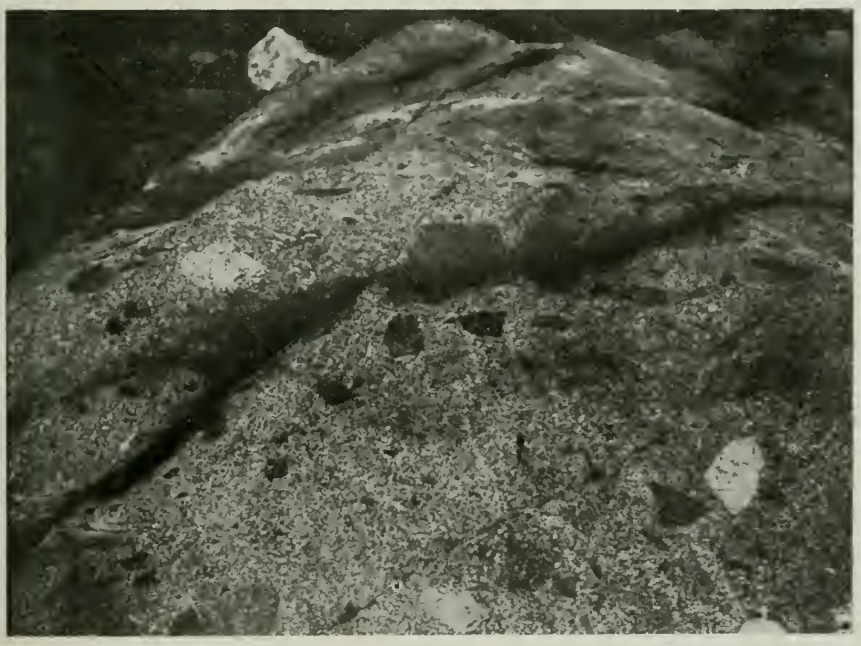


Fig. 13—Anorthosite enclosing diabase and granite fragments.

area is another mass of granite of the same petrological character as the outcrops to the north and south. The only other exposure of anorthosite observed was about a quarter of a mile west of Mud lake, where it assumes a peculiar mottled appearance. A feature of interest was observed at several places, more particularly on the west side of Outlet bay, where the surface of the anorthosite was covered by an igneous breccia, the fragments of which are principally diabase with an occasional fragment of granite (see fig. 13).

The essential difference between the anorthosite and the more common Keewatin greenstone lies in the presence of such minerals as hornblende, augite and biotite in the greenstone, thus giving rise to diorites and gabbros. These greenstones may be considered a more basic phase of the anorthosite.

By earth movements involving pressure and heat, both these rocks may be materially altered in structure and appearance. Schists of various types may be developed which, on account of the ease with which they permit the passage of solutions, are favourable to the formation of secondary ore deposits in veins and fahlbands. Large areas of these schists are developed near Mine Centre. In some cases they have been much crumpled after the original schistosity was developed. When such crumpling is found between comparatively straight bands, it is not always easy to comprehend the processes involved. A good example of this type of deformation is found just north of the Canadian Northern railway about a mile and a half west of Mine Centre. Here the pressure apparently has been applied from about N. 20°W., if we assume that the slaty cleavage is at right angles to the direction of pressure (see fig. 14).

Limestone.—In the Keewatin rocks near the Golden Star mine is a small outcrop of limestone which has been described in considerable detail by Dr. Lawson.[1] In certain portions there is crystallized magnetite and a rough banding suggestive of Iron formation. In many respects it is similar to the limestone associated with the Goudreau pyrite deposits, part of which has been shown by the writer to be a vein formation. In the present case it appears to be a tilted sediment, though bounded above and below by igneous rocks.

The Seine Series

Seine Series.—Inasmuch as the quartzites and slates of this series are not known in this region to be carriers of either iron or copper ores, the writer did not attempt to study them, but has accepted the former mapping.

In the case of the Seine conglomerate certain interesting features were observed, though the time devoted to examining this series was brief, seeing no deposits of immediate economic importance were reported from the region covered by it. In the conglomerate the pebbles are fairly representative of the older rocks and include granites, schists, greenstones and banded Iron formation. In the vicinity of Grassy lake the conglomerate has been squeezed so that it appears as a schist with "eyes" of harder rock, and it is not always clear that it is a squeezed conglomerate. A careful search, however, resulted in the finding of less altered material in which the rounded nature of the pebbles was still visible. The best exposure seen by the writer was about a half mile east of the Golden Star mine, where little if any metamorphism has occurred. The character of the rock is shown by the accompanying photograph (fig. 15). At the contact between the conglomerate and underlying granite at the Golden Star mine, there is an interesting phase which has been discussed by Lawson, and as one result of his interpretation of the phenomena observed the granite has been referred to the Laurentian. This contact phase consists of rounded pebbles more or less metamorphosed, with a matrix consisting largely of quartz, and other material derived from the underlying granite. To this type of material he has given the name "fanglomerate."

[1] G. S. C. Memoir 40, p. 44.

When the writer saw the rock in the field, it appeared to him to be a conglomerate that had been impregnated for several feet with molten granite; under such conditions the granite would be referred to the Algoman series of Lawson. A study of thin sections, both of the granite and the contact phase of the conglomerate, gives evidence that is strongly confirmatory of this interpretation, though in many respects the material is very unsatisfactory. The granite is composed of quartz and feldspars, principally plagioclase, with very little of the common dark minerals. In places the feldspar has been partially altered to sericite, which is possibly the cause of some of the creamy colour seen on a weathered surface.

The conglomerate in this contact zone presents several points of interest. It consists of pebbles from half an inch to four inches in diameter, that for the most part have been water-worn. Between the pebbles there is an abundance of

Fig. 14—Sericite schist, showing secondary crumpling and development of secondary slaty cleavage, Mine Centre.

Fig. 15—Seine conglomerate near Mine Centre.

quartz which has been more or less corroded, and is enclosed in a ground mass that appears to be sericitic. No feldspars were recognizable. Associated with this interstitial material pyrite and molybdenite were recognized, not only in the thin sections but with the naked eye. These sulphides are present only in the interstitial material and not in the pebbles. If this deposit were formed in the manner suggested by Lawson, it is difficult to conceive of conditions that would preserve the molybdenite without visible alteration. Molybdenite is one of the minerals that is seldom if ever found except as a result of igneous intrusion, though frequently it is in rocks that have been metamorphosed by such intrusion. As a result of the presence of this mineral, and in spite of the otherwise unsatisfactory character of the thin sections, the writer is referring the Bad Vermilion granites to the Algoman series rather than to the Laurentian.

Iron Ores

The iron deposits are intimately connected with the anorthosite and gabbro, and are located not far from the granite area which parallels the northwest shore of Bad Vermilion lake and Seine bay of Rainy lake. Near Bad Vermilion lake two workable bodies of ore are present, and occasionally a smaller third one is found; but in the covered region near Seine bay it has not been definitely shown that there is more than one. The ore appeared to be magnetite, though a portion of it was stated by Dr. Goodwin, who was developing the properties, to contain a considerable percentage of titanium and some vanadium. Through Dr. Goodwin's courtesy the writer was enabled to make a microscopic examination of one of the drill cores with a view to determining the relations existing between the ore and the adjoining rock. Several schistose bands were cut by the drill, and it was thought desirable to ascertain whether these represented different types of original rock, or were merely shear zones in the anorthosite-gabbro. Unfortunately, none of the drill holes started in the pure anorthosite, but the relationships are such that there is little doubt that the gabbro is merely a more basic marginal phase of this rock. With the exception of two slides in which the minerals could not be definitely identified by the microscope, the core appears to be divided mineralogically into three distinct portions which are still genetically related, and with the exception of the richer ores all the rock showed plagioclase feldspar or some of its alteration products. A further exception is made of the afore-mentioned two samples where the minerals could not be identified.

The first 67 feet appears to be normal gabbro, and schist derived from gabbro, and is characterized by the presence of plagioclase, calcite and hornblende or biotite, with minor quantities of pyrite and magnetite.[1] In the next 173 feet the character of the rock differed in two respects: augite was the predominant dark mineral, and ilmenite with its decomposition product leucoxene was present as a rock-forming mineral. Pyrite and biotite were present rather uniformly. From this point to the bottom of the hole at 384 feet, augite was lacking, though biotite or chlorite was present in nearly every section. Magnetite[1] was present in every section but one, and ilmenite and leucoxene were not found. A mineral which came as a surprise in connection with the ore bodies was apatite, which was in well formed crystals surrounded by magnetite. The microscopic examination would tend to the supposition that the ore would be rather high in phosphorus. It is also possible that when more material for examination can be secured, the apatite may prove to be the source of the vanadium that has been reported from these ores. This seems probable, as there is no other source indicated by the minerals present in the sections, and vanadium and phosphorus have similar chemical relations.

[1]The analyses made later and given in the text indicate that the mineral recognized as magnetite is in nearly every case ilmenite. In the ore body leucoxene was absent, so that it was not possible to make a distinction between the two minerals, magnetite and ilmenite. The analyses strengthen the supposition that the ore is due to magmatic segregation. On account of the lack of definite chemical formulae for the minerals hornblende, augite, biotite, and chlorite, it has been impossible to make a calculation showing the percentages of these minerals in the rocks.

The ore is in many respects similar to the celebrated Kiruna ores in Sweden, but the associated rocks are very different; the Kiruna ores being immediately associated with syenite porphyry and quartz porphyry. Another more nearly related series is found in Nelson county, Virginia, where ilmenite and apatite form a rock or ore mass which appears much the same in hand specimens as the Kiruna ores.

Origin of Iron Ores

The iron ores of this range have a peculiar interest among Canadian ores, as they furnish a type of deposit which is important in other regions but has not been noted before in Canada. Being associated with great masses of anorthosite, and containing neither siderite, hematite nor limonite, it appears to owe its origin to igneous causes. The one feature favouring a sedimentary origin is the great length of a comparatively narrow band of iron ore. So far as microscopic examination has shown, there is no accompanying rock to which a sedimentary origin could reasonably be assigned. When other similar deposits are recalled—magnetite and titaniferous magnetite containing more or less apatite associated with anorthosite—it seems reasonable to look upon the ore as a magmatic segregation.

Representative samples were taken from the drill core for analysis to show not only the quality of the ores, but to get further light on the genesis of the rocks and ores. The analyses have been made by W. K. McNeill, Provincial Assayer with the following results.

Analyses of Samples from Drill Core, W. L. Goodwin Property, Bad Vermilion Lake

No.	Depth feet	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	H_2O	CO_2	TiO_2	P_2O_5	V_2O_5	S FeS_2	Total.
															FeS_2	
1.....	2	44.14	12.47	5.07	6.72	10.30	1.98	3.50	0.27	2.03	7.20	0.00	.....	.....	6.67	100.35
6.....	64	36.66	14.14	3.93	11.63	11.13	7.84	1.52	0.22	5.41	5.51	Tr	.....	.....	S 2.12	100.13
9.....	79	45.34	21.26	5.39	5.23	7.72	4.06	4.24	0.29	3.34	2.68	.....	0.08	.....	S 0.73	100.36
12.....	93	37.92	18.75	10.56	12.61	4.96	3.78	0.75	Tr	5.02	2.33	2.10	.....	.....	S 1.37	100.15
19.....	130	45.32	20.77	3.23	8.73	7.10	6.72	0.99	Tr	4.89	1.91	.....	.....	.....	.....	100.17
29.....	180	40.34	22.89	2.15	16.16	3.15	4.01	2.02	Tr	6.77	2.19	0.20	0.07	.....	.....	99.95
36.....	253	37.68	21.25	0.65	15.27	8.65	3.14	1.01	Tr	5.66	4.85	0.35	1.78	.....	.....	100.29
37.....	260	4.28	43.67	3.35	22.38	6.15	0.43	0.64	Tr	2.58	0.81	14.40	1.35	Tr	.....	100.04
38.....	276	10.10	21.46	2.73	34.88	1.85	2.20	0.42	Tr	2.14	1.00	23.44	0.06	0.11	.....	100.39
42.....	299	29.80	27.46	1.80	15.28	4.50	3.63	3.58	0.09	4.52	4.50	5.06	Tr	.....	.....	100.22
45.....	356	6.74	5.34	16.08	39.13	0.50	0.75	0.41	Tr	1.84	0.79	27.52	1.10	0.09	.....	100.29
46.....	358	7.60	13.92	9.77	35.80	1.90	3.01	0.67	0.27	2.12	0.88	24.88	.....	0.08	.....	100.90
48.....	371	11.67	36.44	5.77	24.47	5.50	3.18	0.64	Tr	2.51	0.38	4.92	1.70	Tr	.....	100.18
49.....	377	12.08	33.30	6.37	28.09	5.25	3.18	0.70	0.20	3.15	0.36	5.78	1.69	Tr	.....	100.35
50.....	384	14.00	25.18	3.29	27.25	6.20	1.53	0.80	0.62	3.11	5.37	5.80	1.51	Tr	FeS_2 5.06	99.72

Pyrite Deposits at Mokomon

About a mile from Mokomon station on the Canadian Northern railway extensive development work was in progress during the past season in proving the extent of some pyrite deposits on lot B, concession V, Conmee township. The work consisted principally of trenching and diamond drilling. Over a large portion of the property there is a very deep overburden, so that geological boundaries could not be readily seen, and the writer was informed by the former owner of the property that he traced these deposits by means of a dip needle where they were not in evidence on the surface. This use of the dip needle at first seems surprising, as pyrite is one of the minerals which does not affect the dip needle to any extent. It is, however, worthy of note that in most places where pyrite is present

Fig. 16—Pyrite deposit near Mokomon.

there is also some pyrrhotite and possibly magnetite, both of which are magnetic, so that it may be desirable to give more attention to dip needle reading in prospecting even for sulphide ores.

In trenching it was found necessary in many places to sink to a depth of forty feet through a hard boulder clay which required very little timbering. By means of the trenches and the diamond drilling five deposits were proven, and as a result the property was taken over by the Nichols Chemical Company during the winter.

The rocks on the property appear to be principally Keewatin greenstones with some rhyolitic portions, and in a few places a conglomerate was uncovered which is probably to be correlated with the Seine conglomerate. These rocks containing

the pyrite deposits rise quite abruptly from the Kaministiquia valley, along which may be seen a comparatively level terrace which appears in part to be connected with the flat-lying Animikie deposits that are better exposed a few miles nearer Port Arthur.

Details of the extent of the deposits could not be given at the time of the writer's visit, but the accompanying photograph (fig. 16) of a quarry face on one of the deposits will give some idea of size.

Lake of the Woods

In view of the scarcity of platinum and the consequent extremely high price of this metal, the writer was instructed by the Provincial Geologist to examine any known serpentine deposits in the western part of the Province to ascertain whether there might be a source of platinum in this region. Two deposits of serpentinous rock had been observed by the writer in his earlier work on Lake of the Woods, both of which are easily accessible, one being a copper-bearing rock on Allie island, and the other a serpentinized dike in the Welcome channel. These were both visited the latter part of August and samples of about 100 pounds were taken from each place. The samples were sent to W. K. McNeill, Provincial Assayer, but both yielded negative results.

OGAHALLA TO COLLINS

On the National Transcontinental Railway, Ontario

By Percy E. Hopkins

Introduction

The following report gives the results of an examination made during June and July, 1917, along the line of the National Transcontinental railway for a distance of 175 miles between Ogahalla station, at the crossing of the Kenogami river, and Collins station, which is located on Trout lake some 30 miles northwest of Lake Nipigon. The route over this railway from Winnipeg to Cochrane is described in Guide Book No. 9 of the International Geological Congress, 1913, by Messrs. A. G. Burrows, W. H. Collins and M. E. Wilson. In that report the central portion of the route is described only in a general way owing to the line of railway not being finished at that time; hence these notes will add to the information contained in the guide book. In addition, some exploratory canoe trips were made inland for the purpose of inquiring into the mineral possibilities of the areas. A pyrrhotite deposit on Pine lake was examined, and water routes not previously mapped between Smooth Rock, Caribou and Round lakes were investigated. The sketch maps accompanying the report were prepared by Messrs. W. J. Bell and P. A. Jackson of the Bureau of Mines staff. The assays mentioned in the report were made by Messrs. W. K. McNeill and T. E. Rothwell of the Provincial Assay Office.

Ogahalla to Cavell

A. G. Burrows when examining the line of railway in 1912 was able to get as far west as the Kenogami river, a large picturesque river famed for its speckled trout and sturgeon. From Kenogami river to Cavell and on to Kowkash station, (fig. 1) may be spoken of as the western part of the northern Ontario clay belt, These clays were probably deposited in lake Ojibway. Associated with the stratified clays are varying amounts of boulder clay, sand, gravel, peat, erratics and frequent exposures of hornblende and biotite granite and granite gneiss, which make the area on the whole unsuitable for agricultural purposes. It is, therefore, considerably rougher than the vast clay belt which extends from the Kenogami river easterly into the Province of Quebec. Cutting the Laurentian gneiss at mileage 111.7 (fig. 1) is a narrow Keweenawan (?) diabase dike. Grant, a divisional point on the railway, is surrounded by grey granite gneiss which is cut by red granite. South of Grant on Pine lake is a large pyrrhotite deposit carrying low values in copper, nickel and gold. The deposit is referred to in more detail in a following paragraph. From Opemisha to Paska station, a distance of 40 miles, there are extensive sand and gravel deposits with numerous kettle lakes, representing probably a pause in the front of the great ice sheet which at one time covered this whole area.

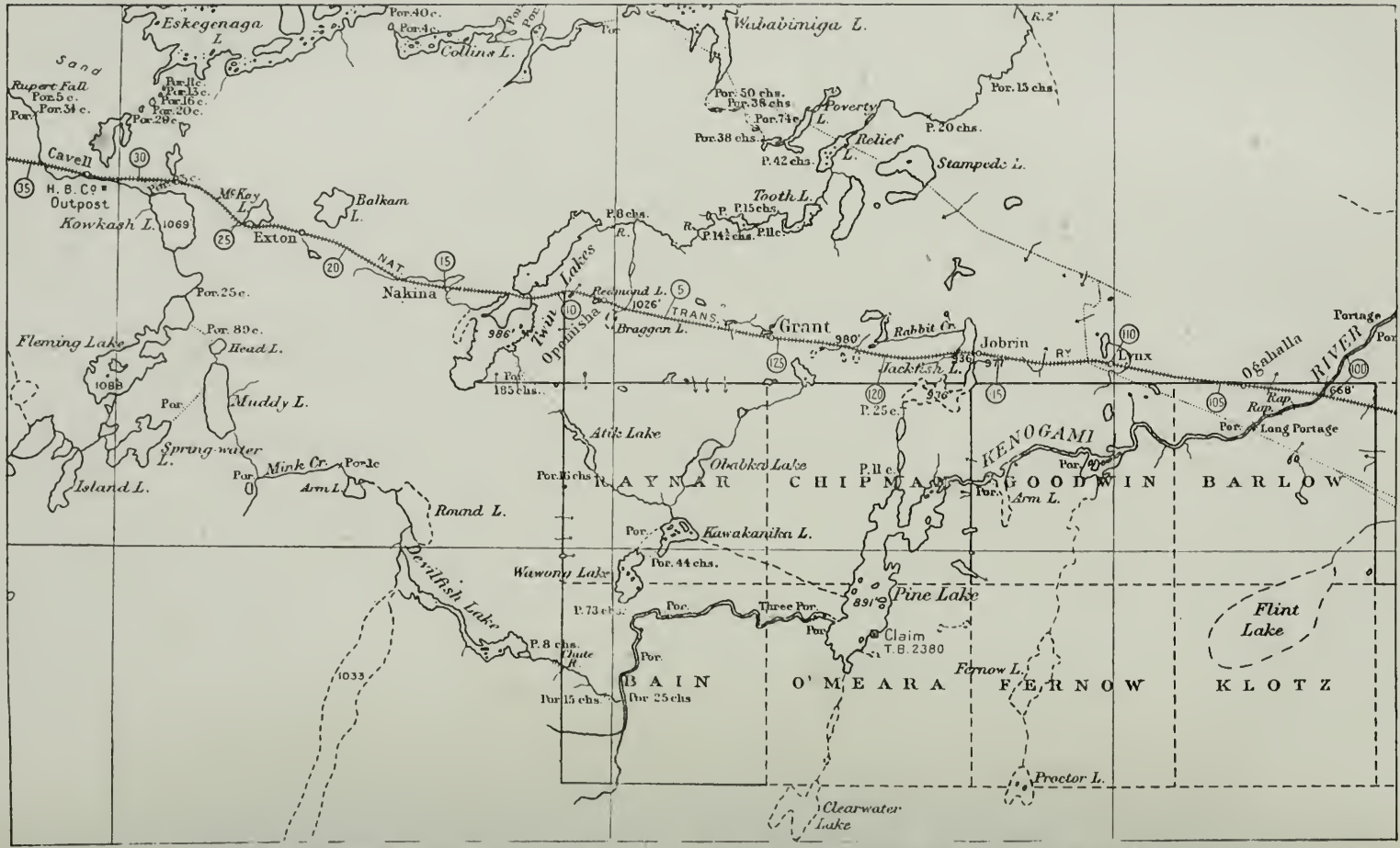


Fig. 1—Route map between Ogahalla and Cavell stations, N. T. Ry. Grant is a divisional point. Every 5-mile post on the railway is shown. Scale, 8 miles to the inch.

Cavell to Ombabika

For the route between Cavell and Ombabika the reader is referred to the report and map of the Kowkash Gold Area.[1] The rocks here belong largely to the Keewatin complex, consisting dominantly of basalt, quartz porphyry, slate and Iron formation. There has been considerable work done on gold prospects at Howard falls, 9 miles north of Kowkash and in the vicinity of Tashota. At the present time (April, 1918) this work seems to have been discontinued. Iron deposits were also investigated in 1906 and 1907 on the Onaman iron range, near where Paska station is now situated. Some promising-looking iron pyrites deposits also occur in the area. The railway crosses the height of land, altitude 1,118 feet, one-half mile to the east of Redmond. To the east of this watershed, the waters drain northward into James bay while to the westward they drain into Lake Superior.

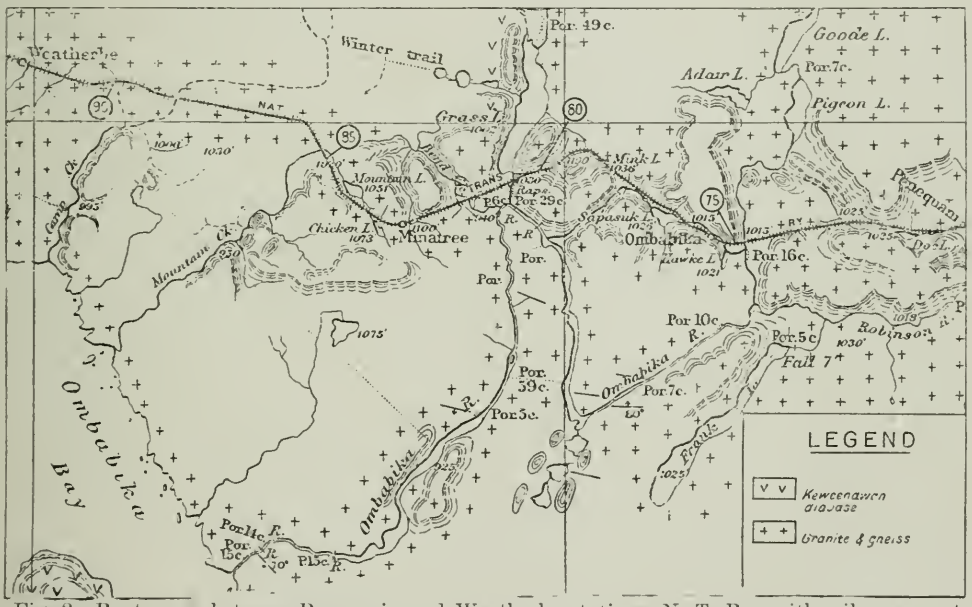


Fig. 2—Route map between Pencquain and Weatherbe stations, N. T. Ry., with mileages west of Grant. Base from Map No. 8A, Geol. Sur. Canada. Scale, 4 miles to the inch.

Ombabika to Collins

The Ombabika river is a well-travelled route which is used in going from Lake Nipigon to the Albany river, and thence to James bay. Practically the whole distance from Ombabika to Collins, as shown by figs. 2, 3 and 4, is underlain by Laurentian hornblende, biotite granite gneiss and some younger granites, and overlain with small remnants of Keweenawan conglomerate and sandstone, which are in turn capped by diabase. The area on the whole has been burned, giving it a bleak appearance. Considerble drift, consisting chiefly of stratified sand and clay, occurs between mileages 104 and 127. The deposits, which are at least

[1] Ont. Bur. Mines Report, 1917, Vol. XXVI, pp. 190-226.

100 feet in thickness as seen in some of the stream beds, were probably laid down in glacial Lake Warren that formerly occupied the Lake Nipigon basin. Near Weatherbe, at mileages 91.3 and 93.3, narrow dikes of diabase cut the grey hornblende gneiss. Lake Nipigon can be seen from the railway only at a few intervals in the vicinity of Ferland. Mileage 102, immediately west of Ferland, is spoken of as "the summit." At this point the railway passes through

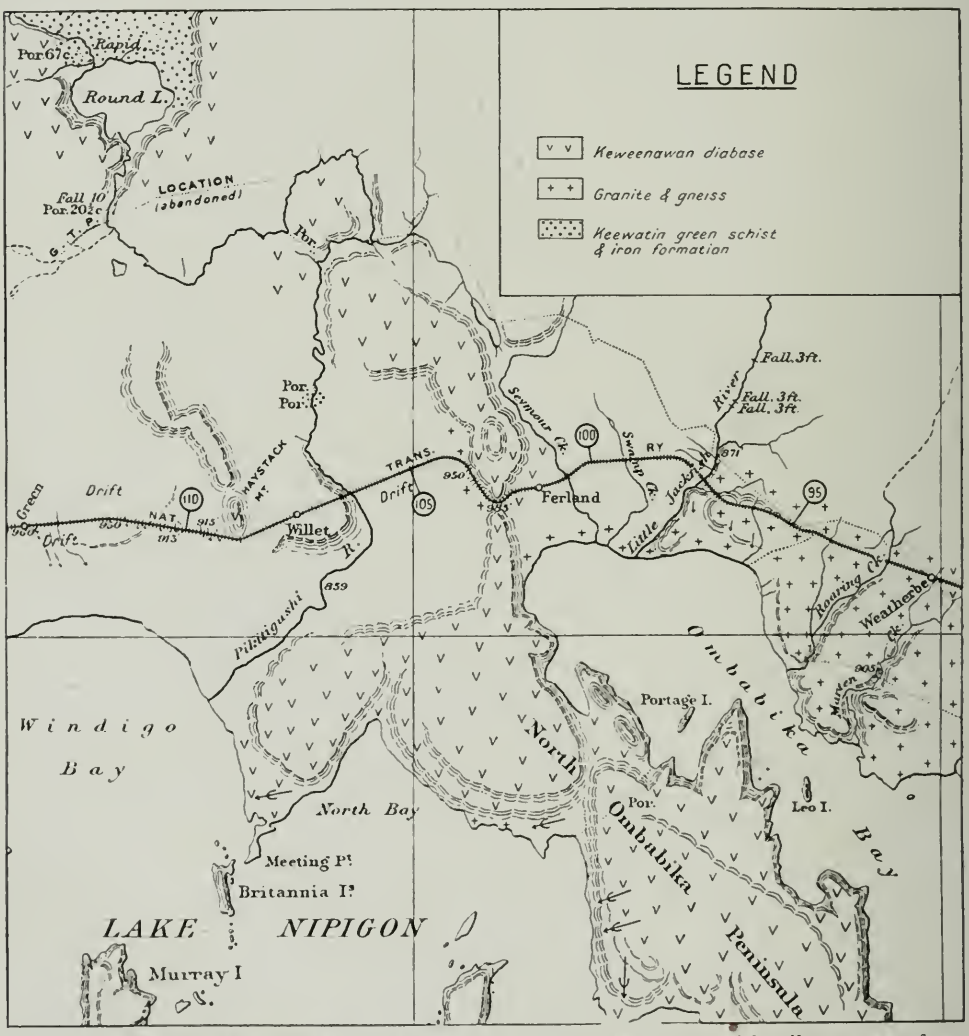


Fig. 3—Route map between Weatherbe and Green stations, N. T. Ry., with mileages west from Grant. Scale, 4 miles to the inch. Base from Map No. 8A, Geol. Sur. Canada.

a gap in a prominent north and south ridge of Keweenawan diabase whose southerly extension forms the prominent North Ombabika peninsula, on Lake Nipigon. Immediately west of the ridge can be seen the underlying gneiss. The railway crosses the Pikitigushi or Mud river near Willet at mileage 106, this point being 7 miles by river from Windigo bay, the northwestern part of Lake Nipigon. The fact that this is the only stream navigable for launches between

Fig. 1. Route map (scale, 4 miles to the inch) between Collins station and Lake Nipigon, N. T. Ry., showing geology and topography in the vicinity of Caribou and Pillar lakes, not covered by Map No. 993, Geol. Sur. Canada.

the railway and Lake Nipigon will tend to make Willet an important place for tourists or anyone wishing to communicate with Lake Nipigon. About the only rock exposure in this vicinity is a conspicuous, conical-shaped hill of Keweenawan diabase known as Haystack mountain, which is situated one mile west of Willet north of the railway. The hill has an altitude of 1,266 feet by aneroid, and may be seen from many parts of Lake Nipigon, 30 to 40 miles distant. It is the intention of the Ontario Government to build a look-out tower on this hill for use in connection with its forest protection system.

The Whitesand river is crossed at mileage 123.3. Speckled trout may be caught in this river, as in most streams between Ombabika and Collins.

Armstrong is a divisional point surrounded by granite, gneiss, conglomerate, sand and boulders. The massive, fresh-looking granite, at a point on the railway five miles west of Armstrong, contains large inclusions of hornblende granite gneiss, showing that the granites are of two ages. A knoll of reddish Keweenawan conglomerate may be seen lying on the gneiss about 100 yards south of the town. Molybdenite is reported to occur in patches in the granite on some of the islands in Tunnel lake about two miles south of the railway, while float containing molybdenite was also reported to have been found on Trout lake near Collins. A thin sheet of diabase, only a few feet thick in places, lies on the granite gneiss in the vicinity of Pascopee station between mileages 13 and 15. This diabase can be traced southeasterly for 25 miles to Lake Nipigon, the sill increasing to 400 or more feet in thickness as Lake Nipigon is reached. From Pascopee to Collins and for many miles to the west granite gneiss is the prevailing rock.

Armstrong and Vicinity

The geology in the vicinity of Armstrong was examined while making a track survey of several lakes, viz.: McLaurin, Mackenzie, Mattice, Castle and Pillar. Brook trout are plentiful in many streams connecting these lakes. Much drift, especially sand, occurs in the area. The underlying rock is Laurentian granite and gneiss, as may be seen at numerous places along the railway. Lying on the gneisses are occasional thin horizontal beds of conglomerate and sandstone. (See fig. 4.) A few hundred feet south of Armstrong the conglomerate is at least 20 feet thick, and contains numerous round and angular crystalline fragments. The conglomerate and red sandstone on the shores of Pillar lake lie under and adjacent to a diabase sheet which is at least 250 feet thick. The diabase overlies all the other rocks in the immediate vicinity, and is the prevailing rock. It is 200 or more feet in thickness, and has a characteristic, vertical, columnar structure. This jointing is most beautifully shown on the shores of Castle lake, 7 miles southwest of Armstrong, where many of the vertical columns have fallen over. Frequently isolated columns present castle-like effects, as shown in the accompanying photographs (figs. 5, 6, 7 and 8). Numerous calcite stringers carrying considerable pyrite occur on the east and west shores and near the extreme south end of McLaurin lake. These narrow veins range up to three inches in width and cut the massive diabase at various angles. Samples from several of the veins, however, were found on analysis by W. K. McNeill to contain no silver.

Fig. 5—General view of Castle lake and vicinity.

Fig. 6—Columnar diabase rising about 200 feet above Castle lake.

Fig. 7—View at close range of some of the diabase pillars on "Castle Hill," Castle lake.

Fig. 8—Columnar diabase on Castle lake, eight miles southwest of Armstrong station.

Molybdenite on Tamarack Lake

Six miles north of Collins station on the northeast shore of Tamarack lake, and less than a quarter of a mile from the portage which runs from the lake around a falls at the mouth of the Boiling-sand river (fig. 4) molybdenite occurs in a coarse flesh-coloured biotite granite or pegmatite dike, which is at least 20 feet wide and intrudes biotite granite gneiss. A sample containing molybdenite was found on analysis to carry no gold. Although the molybdenite occurs disseminated through the rock in flakes up to one-quarter of an inch across, yet the mineral did not appear to be present in economic quantity. However, the locality might be a favourable one in which to do some prospecting, since no trenching had been done.

Fig. 9—Indian graves on Smooth Rock lake. The coffins are placed above ground and are covered frequently with canvas. July, 1917.

Smooth Rock Lake

Smooth Rock lake, shaped like a huge devilfish, is some 25 miles across and contains many islands. The general character of the shores and islands is low, almost continuous rock with little soil covering, and the timber recently burned, consequently, there are few black flies or mosquitoes in the area. Exploration party No. 7 of the Ontario Department of Crown Lands, in charge of H. P. Proudfoot, O.L.S., with F. J. Snelgrove as geologist, passed through Smooth Rock lake in 1900, made a micrometer-log-compass survey of part of the lake and found the geology to consist of Laurentian hornblende granite gneiss.[1]

Lying on or cutting the gneiss on the north shore and halfway down Lone Breast bay is an olivine diabase, probably a sill remnant, 200 feet in height. Under the microscope the labradorite laths are set in a groundmass of augite containing

[1] Report on Exploration of Northern Ontario, 1900.

numerous grains of olivine and much magnetite. Some miles farther west at the narrows of the same bay is another outcrop of Keweenawan (?) diabase. Between these outcrops of diabase there is hornblende schist cut by a massive grey biotite granite. An island in Lone Breast bay to the south of the olivine diabase hill consists of banded "sugary" quartz, and pyrite striking nearly east and west and dipping vertically. The rock resembles portions of the altered Iron formations on Caribou, Round and Marshall lakes. The guide, Alfonso D'Alton, stated that similar rock occurs on the first small lake northeast of the outlet of Lone Breast bay, and on the west side of Outlet bay, Smooth Rock lake. The writer was also informed that Lone Breast bay drains by a large river and three lakes with three portages on the route, northeasterly into Whitewater lake. This being the case, Smooth Rock lake has at least three outlets. Smooth Rock lake is 20 feet lower than Caribou lake, as determined by the drop in the falls and rapids on Caribou river which connects the two lakes. The writer made a track survey of the east bay of Smooth Rock lake, Caribou river and Outlet bay of Caribou lake. The four short portages on Caribou river are over Keweenawan diabase, the remainder of the route being through Laurentian granite gneiss and pegmatite.

Caribou Lake

A micrometer-compass survey of Caribou lake and a geological examination of its shores and islands were made by W. H. Collins[1] in 1906. The writer spent two or three days on the lake before examining the area to the east between Caribou and Round lakes. The outlet bay or commencement of Caribou river which had not been previously mapped is surrounded by granite and gneiss (fig. 4).

A portion of the northeast end of the lake was examined. Here two small lakes, one of which is called Fletcher lake, drain from the north into a long bay on the northeast end of Caribou lake. The rocks in the vicinity, as shown in fig. 4, consist dominantly of Keewatin pillow lavas, with some narrow bands of Iron formation, quartz porphyry, hornblende schist and rusty carbonate, striking a little north of east. The Iron formation consists of alternate bands of magnetite, usually an inch or two in width, and sugary quartz. Collins refers to a band of magnetite 12 inches wide from this vicinity. In places much iron pyrites occurs in the formation, but neither iron nor iron pyrites were seen in economic quantity. The quartz porphyry contains numerous quartz and some feldspar phenocrysts, and resembles the quartz porphyries accompanying the Iron formation in Deloro township and in the Onaman and other iron ranges. Capping these older rocks in places are Keweenawan diabases, the conspicuous outcrop being known as Kellar's peak, which is at least 400 feet high. Four miles southwest of Kellar's peak and on the northeast end of an island which is at least one mile long is a quartz vein, six inches wide, containing copper pyrites. A sample from this vein yielded on assay 80 cents of gold to the ton. At the extreme northeast end of Caribou lake is a portage 25 chains long which passes over a water divide. The rocks on this portage are hornblende gneiss and quartz-porhyry schists, which strike east and west and dip 70 deg. to the south, and may represent a recurrence of the Laurentian.

[1] A Geological Reconnaissance of the Region traversed by the National Transcontinental railway between Lake Nipigon and Clay lake. Can. Geol. Surv. Report No. 1059.

Caribou Lake to Pikitigushi River

For some time rocks belonging to the Keewatin complex have been known to occur on Caribou lake and 18 miles to the southeast in the vicinity of Round lake, but little has been known of the intervening area. A. W. G. Wilson, however, found these schist rocks to continue across the interval between the northeast end of Caribou lake and Pikitigushi river.[1] The writer made a track survey and geological examination along a chain of lakes and streams through this area, which resulted in the delimiting of a portion of the south boundary of the Keewatin area as shown in fig. 4. This route commences by a small portage which leaves Caribou lake at a point approximately six miles from its northeast end. The portage passes over the height of land into a small pond which drains by means of streams and lakes easterly into the Pikitigushi river at a point about ten miles above Round lake.

The Keewatin rocks in this area consist of massive and schistose diabase and greenstone rocks which frequently show the ellipsoidal structure. In addition to green schists there are hornblende, chlorite and talc schists, rusty carbonates and Iron formation. These rocks strike from northeast-southwest to east and west, and usually have a vertical dip. The Iron formation, which consists of sugary quartz and magnetite, occurs in bands up to 50 feet in width, at frequent intervals from the west side of Caribou lake to Round lake. One of the richest outcrops seen occurs on the south central shore of Moon lake, but nowhere did the iron appear to be in commercial quantity. In places, viz.: on Fletcher, Michell and D'Alton lakes, the Iron formation is accompanied with varying quantities of iron pyrites, as is frequently the case in other parts of the Province. The outcrop of sugary quartz on the southeast shore of Michell lake is at least 500 feet long, 3 feet wide and contains about 50 per cent. of disseminated iron pyrites. Fuchsite, a chromium-muscovite, occurs in bands up to a foot in width near the same locality.

Quartzose schists, resembling Lawson's Couchiching series and the Marshall lake series, occur at the 25-foot falls on the west end of Pawshowconk lake, also near the northeast end of Caribou lake and on Lone Breast bay, Smooth Rock lake. Moore[2] describes similar rocks with the Iron formation at Round lake.

Cutting the old rocks at the east end of Michell lake and in the vicinity of Fuchsite and Cunaway lakes are numerous, narrow quartz porphyry intrusions post-Keewatin in age. Under the microscope the white-weathering porphyries are seen to contain numerous quartz, feldspar and biotite phenocrysts in a micro-crystalline groundmass of the same composition. Quartz veins, varying from a few inches to two feet in width and carrying iron pyrites and copper pyrites, were seen in the area. A sample from a vein near the rapids between Michell and Fuchsite lakes gave on assay 40 cents of gold to the ton. It would appear that this particular area is worthy of prospecting for gold, since gold-bearing veins are frequently found in a similar association of rocks throughout many parts of central Canada.

[1] Memoir No. 1, Geology of the Nipigon Basin, Can. Geol. Surv., p. 51.
[2] Ont. Bur. Mines Report, Vol. XVIII, 1909, Pt. 1, p. 158.

Three small areas of hornblende granite and gneiss occur in the area, viz.: at the first portage between Caribou lake and the stream running into Michell lake, and on the southwest and southeast shores of D'Alton lake.

Lying unconformably on the old Keewatin on Moon lake is a small area of nearly flat-lying conglomerate and grey sandstone at least 10 feet in thickness. The conglomerate contains well-rounded pebbles consisting of white quartz, Iron formation, granite gneiss, etc., embedded in a greywacké groundmass. The sediments are probably Keweenawan in age, since they resemble the isolated patches to the south in the vicinity of Lake Nipigon. The exposures on Moon lake are the most northerly known Keweenawan sediments in the Lake Nipigon basin.

Capping all the rocks referred to above is the diabase of the Nipigon sill. A prominent ridge or sill remnant passes all the way from the Pikitigushi river across the south sides of Reef and D'Alton lakes, and probably joins up with the diabase on the southeast shore of Caribou lake, fig. 4. Much of this ridge was burned over in the summer of 1917.

A few calcite veins up to one foot or more in width were seen conforming with the strike of the Keewatin schist on the islands and shores of Reef lake. No metallics were noticed in the veins, and samples from three different veins show the absence of silver on assay; nevertheless, the presence of such veins in a formation quite similar to that at Cobalt might warrant some of these calcite veins being prospected for silver. According to an old Indian report, silver was obtained from a calcite vein projecting out of the water on Reef lake at a point near where the river enters from Moon lake.

Pyrrhotite on Pine Lake

Pine lake, an expansion of the Kenogami river, lies about eight miles southeast of Grant station. The rocks surrounding the lake consist chiefly of Laurentian (?) hornblende granite and gneiss. These are cut by massive red biotite granite and a few narrow dikes of diabase, probably of Keweenawan age. On the southeast shore of the lake on claim T. B. 2390, (fig. 1), are three parallel bands of pyrrhotite which have been referred to by E. V. Neelands.[1] The deposits occur in a hornblende gneiss, strike slightly north of west for 100 feet and dip vertically. The south vein, which is at least 10 feet wide, consists of massive, granular pyrrhotite with a little pyrite and disseminated grains of quartz or chalcedony. A chipped sample across 10 feet yielded on assay[2] the following: Nickel 0.14 per cent.; gold 40 cents per ton; copper, none, and platinum, none. The middle band, which lies 50 feet to the north, is approximately six feet wide, and consists dominantly of pyrrhotite with some pyrite and a little disseminated molybdenite. The northerly deposit, 100 feet from the middle one, is about 10 feet wide and contains some pyrite and chalcopyrite. A few samples from the latter body yielded on assay[3] the following: Copper 0.40 per cent.; nickel 0.26 per cent.; gold, none, and platinum, none.

[1] Survey and Exploration of Northern Ontario, Department of Crown Lands, Ontario, 1900, p. 149.

[2] Assay by W. K. McNeill.

[3] Assay by W. K. McNeill.

The rocks on Little Pine lake are almost horizontal, and are similar to those on Pine lake, namely, Laurentian (?), hornblende-chlorite gneiss. These are cut by massive, flesh-coloured biotite granite. No mineral deposits of any value were seen on the lake. Little Pine river, the outlet, flows with a swift current through an excellent agricultural area.

Economic Notes

No minerals in economic quantities have been found in the area, yet one would infer from the geology and mineralogy that certain localities are favourable for gold, molybdenite, iron pyrites and probably for iron and silver.

Gold.—In the Kowkash and Tashota area there are several gold prospects which are described by the writer in the report on that area. The Wells property near Tashota is the one on which most work has been done. Here a shaft 140

Fig. 10—Workings on pyrrhotite deposits, mining claim T B 2390, Pine lake, June, 1917.

feet deep and some lateral work on the 90-foot level show that there is an auriferous quartz deposit reported to average $5.00 in gold to the ton across five feet. Apart from the Kowkash-Tashota area which has been prospected only in a few parts, there is an unexplored area of similar rocks, extending at least from Caribou to Round lake, which might be worthy of prospecting for gold. Samples yielding 40 cents and 80 cents of gold per ton were obtained from veins on Caribou and Fuchsite lakes. In the vicinity of the latter lake the rocks consist of green schists intruded by numerous quartz porphyry dikes, an assemblage of rocks in which gold-bearing veins are frequently found.

Molybdenite.—The presence of molybdenite in granite and pegmatite on Tunnel and Tamarack lakes and in float on Trout lake, shows that molybdenite occurs over a wide area, and warrants a further search for the mineral in the vicinity.

Iron Pyrites.—Several deposits of iron pyrites occur in the Kowkash-Tashota area which would justify further exploration. Most of these deposits are described

in the report on the Kowkash area, the more important locations being marked on the map accompanying that report. On account of the present scarcity of sulphur the iron pyrites might be used in the making of sulphite pulp at the pulp-mills in northern Ontario. Deposits of little or no importance were seen on an island in Lone Breast bay, Smooth Rock lake, on Fletcher and Michell lakes, and with the iron formation at Round lake.

Iron.—Two iron ranges occur in the area, viz.: the Onaman range, consisting of a north and a south band in the vicinity of Paska station, and the Round lake range, which extends intermittently in a westerly direction to Caribou lake. The Onaman range, apparently the richer of the two, has on the whole too much rock interbanded with the narrow magnetite layers to make the deposits of economic importance; however, E. S. Moore who examined the deposits in detail in 1907 [1] and 1908 [2] regards the eastern end of the southern range, which lies two and three-quarters miles south of Paska station, to be worthy of further prospecting.

Photo by E. S. Moore.

Fig. 11—"Haystack" mountain, N. shore of Lake Nipigon.

Silver.—Silver was obtained in only one sample in the area, viz.: on the McKinnon claim which lies one and three-quarter miles north of Tashota. On this claim there is a large quartz vein, 25 feet wide in places, which contains a dark streak a few inches wide, rich in galena, zinc blende and chalcopyrite. Samples of the sulphides from this vein gave on analysis $1.00 of gold and 11 ounces of silver per ton. Numerous narrow calcite veins were seen cutting the diabase sill on McLaurin lake, to the southwest of Armstrong, but no silver values were obtained in the several samples which were assayed. Several calcite veins up to one foot in width occur in the Keewatin, which is capped by conglomerate and sandstone, and in turn by diabase, in the vicinity of Moon and Reef lakes. No silver values were obtained from these veins, but one would infer from the geology that such calcite veins are worthy of further investigation.

[1] Ont. Bur. Mines Report, Vol. XVII, 1908, pp. 170-189.
[2] Idem, Vol. XVIII, 1909, pp. 196-253.

NOTES ON LAKE ABITIBI AREA

By Percy E. Hopkins

Introduction

During September and part of October, 1917, a part of the Lake Abitibi Area was explored. This included a geological examination of a large portion of the shores and many islands of the Abitibi lakes. Examinations were also made of part of the Ghost river and a recent gold discovery in Rickard township. In addition, a track survey was made of the Okikodosik and Patten[1] rivers, and a trip made over a trail 15 miles north of Hughes station where silver was reported to have been found. Sketch maps of the various parts examined are embodied in the report. These were drawn by P. A. Jackson. The analyses of samples collected were made by W. K. McNeill, Provincial Assayer.

Fig. 1—Lifting pound nets, Lower Abitibi lake, September, 1917.

Only cursory examinations of the Abitibi area had been made by various explorers previous to M. B. Baker's[2] more detailed examination in 1908. Since that time the area has been made easily accessible by the construction of the National Transcontinental railway which touches the northern part of Lower Abitibi lake in places, and crosses several streams flowing into Upper Abitibi lake. Low Bush and Mace stations are within a few hundred feet of the lower lake, while La Reine and La Sarre stations in Quebec are on the Okikodosik and Whitefish rivers, 5 and 8 miles respectively from the upper lake. The excellent transportation facilities afforded by the railway and large waterways have attracted tourists and greatly aided the farming, fishing and pulp industries of the area. The Abitibi Pulp and Power Company are obtaining large quantities of pulpwood

[1] The name "Patten river," approved by the Geographic Board of Canada, has been substituted for that of "Woman river," there being several rivers in Ontario to which the name Woman has been given.

[2] Ont. Bur. Mines Report, Vol. XVIII, Pt. 1, pp. 263-283.

from their limits around the lakes. Owing to the lands not having been opened for settlement, no farming is being carried on at present in this part of Ontario, but on the Quebec side numerous farms have been located and large clearings made in the vicinity of the railway. A fishing industry has been established, the fish consisting of whitefish, pickerel, pike and suckers. Prospecting is hindered in part of the area by the scarcity of rock outcrops, but gold discoveries were made in 1917 in Rickard township, and also near the source of the Lightning river.

Topography

The country as a whole is low, flat and largely drift-covered, being part of what is generally known as the Great Clay belt. The long railway tangents suggest that the country is level and free from much rock. No rock was seen

Fig. 2—Hudson's Bay Company post, Upper Abitibi lake, Quebec, established in 1755. The two buildings in the foreground, over 50 years old, have been flooded recently by the raising of the level of Abitibi lake. The new buildings are in the background.

along the railway from Cochrane easterly to the crossing of the Low Bush river, a distance of 42 miles. The roughest part of the area is immediately south of Upper Abitibi lake, where numerous hills rise 300 to 600 feet above the lake.

Lake Abitibi, consisting of Upper and Lower lakes connected by a narrow channel, is a large but shallow lake, with an area of 350 square miles and a watershed of 3,735 square miles. The lake level was raised in 1913 by the building of a temporary regulating dam at Couchiching falls on the Abitibi river, five miles from the lake, by the Abitibi Pulp and Power Company. At this dam and at Low Bush water gauges are read daily, the datum being that of the National Transcontinental railway. The company endeavours to maintain a normal high water level not exceeding an altitude of 878.5 feet. For the year 1917, however, the average level of the lake equalled the above figure, due to the excessive precipitation during the months of June, July and August. Wind tides also have a very perceptible effect in changing the elevation at different parts of the lake.

There is a projected development by the Abitibi Company of Twin Falls on the Abitibi river, the power house to have four units operating under a head of 55 feet and using 4,500 cubic feet per second. This development will maintain the river above the dam at lake level and drown out Couchiching Falls entirely. Construction work was suspended temporarily early in 1917, the foundations of the dam being well under way at the time. At present the company derives power from Iroquois Falls, farther down the river. Twin Falls will supplement this.

General Geology

The geology of the area has been described by Mr. Baker; hence only a brief summary and a few additional notes will be given. The accompanying sketch maps (figures 8 and 9) serve to show the actual rock outcrops in certain areas.

Fig. 3—National Transcontinental railway crossing of the Lowbush and Circle rivers, September, 1917.

Keewatin

The Keewatin consists dominantly of pillow lava and altered diabase, with subordinate amounts of agglomerate, conglomerate (?), slate, Iron formation, dolomite, and hornblende and chlorite schist.[1] The large volume of these volcanic rocks is a striking feature of the south shore of Upper Abitibi lake. Despite glaciation, the surface is rough and much broken, from the uneven weathering of the rocks, due to their ellipsoidal structure and the abundance of calcite. The principal area of slate and greywacké lies in the vicinity of Mace station. These fine-grained grey rocks may be composed partly of volcanic fragmental material which has been water-sorted. They strike about N. 80° E. and dip vertically, and may be continuous with the sediments on the west shore of the lake.

[1] These rocks are called Abitibi Volcanics by M. E. Wilson. Geol. Surv. Can., Mem. No. 39, Kewagama Lake Map-Area.

Intrusives

These older rocks are intruded by serpentine, granite, and diabase, the latter two being described by Baker as Laurentian and post-Middle Huronian, respectively. Their ages have not been definitely determined, since sediments of Timiskaming age have not been found in association with them.

On the east shore of Lower Abitibi lake is a massive dike-like mass of serpentine or altered peridotite clearly cutting Keewatin graphitic schists. A definite age has not been established. However, the serpentine resembles some of the serpentine deposits of the Porcupine area and those in Dundonald and Reaume townships, which are considered to be pre-Algoman in age.

Much of the quartz diabase and gabbro of the area appears to be younger than the Keewatin in the field, and yet has a slightly older look than the Nipissing diabase at Cobalt, and may also be pre-Algoman in age. Such rocks may be seen on the Ghost hills, (fig. 8), south of Upper Abitibi lake, in the new township of Lamplugh, and also on the Okikodosik and Patten rivers. Microscopic examination of these rocks confirms the field evidence. A sample from a point on the west shore of Upper Abitibi lake and one and a half miles south of the narrows, shows the feldspars altered to kaolin and sericite, and the augite to hornblende and chlorite, there being many graphic intergrowths of quartz and altered feldspars. Gold-bearing quartz veins are reported to occur in the altered quartz gabbro near the mouth of Patten river, (fig. 9). This rock resembles the diabase-gabbro intrusions of Robb township,[1] and Beatty and Munro townships,[2] where gold is also found. The diabase on Shaft or Gold island in Lower Abitibi lake contains a quartz vein carrying visible gold, and may be of pre-Algoman age also.[3]

The hornblende and biotite granites and syenites occur as batholiths, stocks and dike-like masses. The rocks are usually quite massive and fresh, thus resembling Algoman granites in other areas. The fact that gold occurs in a pegmatitic vein on lot 4, concession C, Steele township, and in a quartz vein cutting the granite in South bay, Lower Abitibi lake (see fig. 9), suggests that some of the gold deposits of Lake Abitibi are genetically connected with the granites.

Many of the quartz diabases cut the rocks described above and resemble, both megascopically and microscopically, the quartz diabases of the Cobalt area. Even if some of the diabases are Keweenawan in age, it will be difficult to separate them from the pre-Algoman (?) diabases. Silver appears to have accompanied the diabase intrusion at one place, viz.: north of Hughes station, to which further reference is made below. Should the Shaft or Gold island gold deposit belong to the Keweenawan epoch, then this is another example of gold deposition in the latter. The only other known similar gold-bearing deposits in Ontario which have been assigned to this age are those at the Crystal gold mine on Wanapitei lake and the Havilah mine north of Thessalon.[4]

[1] Ont. Bur. Mines Report, Vol. XXIV, Pt. 3, 1915, pp. 58-60.
[2] Ont. Bur. Mines Report, Vol. XXIV, Pt. 1, 1915, p. 180.
[3] Ont. Bur. Mines Report, Vol. XXIV, Pt. 1, 1915, pp. 243-248.
[4] Geol. Surv. of Can., Memoir No. 95, pp. 114-116.

Fig. 4—Collection of moose antlers by Indians, north of Ghost river, Abitibi lake. The large set has a spread of over five feet.

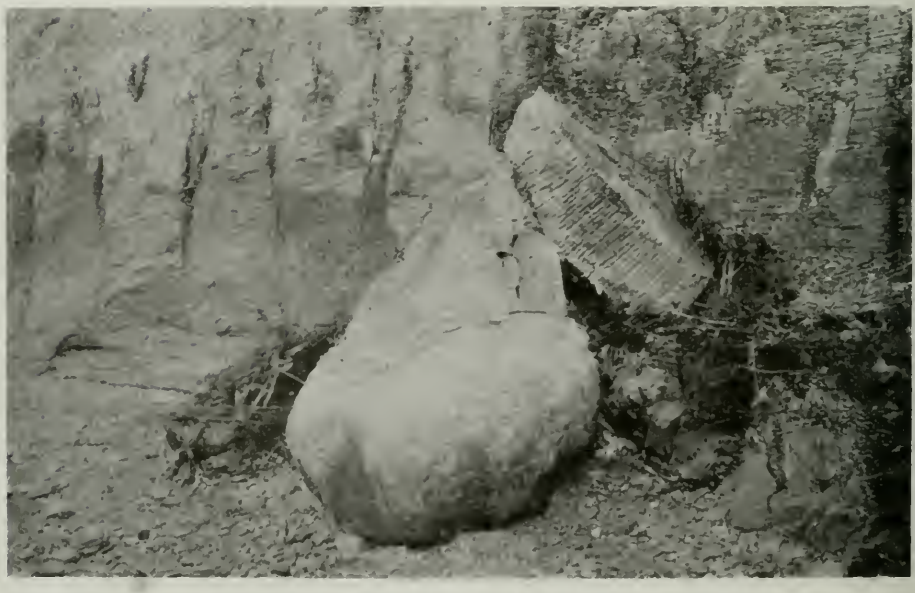


Fig. 5—Rounded greenstone boulder in stratified clay at cabin near mouth of Mattawasagi (Teddy Bear) river, Upper Abitibi lake, September, 1917.

Pleistocene

The drift deposits consist largely of stratified clay or clay and sand, which were deposited in a huge glacial lake named Lake Ojibway by A. P. Coleman. A beautiful section of the stratified clay, 15 feet thick, may be seen at the Indian cabin near the mouth of Teddy Bear or Mattawasagi river, township of Stoughton, (fig. 8). There are from 10 to 15 double layers in a foot-section of the clay. Near the bottom of the section the layers are slightly wrinkled and contain an occasional large, smooth boulder, probably representing glacial till. The rocks which rise through the clay have been glaciated, the striæ striking from 10° to 20° to the east or west of south, astronomic.

Fig. 6—Stratified clay at Indian cabin, near mouth of Mattawasagi (Teddy Bear) river, Upper Abitibi lake, September, 1917.

Economic Geology

Chromiferous Serpentine

On the east shore of Lower Abitibi lake, on lots 3 and 4, concession C, Steele township, is an occurrence of chromiferous serpentine which was discovered in 1909 by M. B. Baker. Mr. Baker was unaware of the presence of chromium until a laboratory examination was made of the serpentine collected. Since he did not return to the area, and owing to the importance of chromium in the steel-making industry in the form of chrome-steel for guns, armour-plate and tool-steel, it seemed advisable that a further examination should be made of the occurrence.

The massive serpentine, or altered peridotite, occurs as a dike-like mass cutting Keewatin graphitic schists, and is classed as pre-Algoman in age since it resembles the pre-Algoman serpentine in other parts of northern Ontario. The rock outcrop is larger than stated by Baker, having an area of at least five acres. The serpentine contains much finely disseminated magnetite and minute veinlets

of the same mineral. The rock is cut by narrow calcite veins carrying some talc. No reddish-brown streak, suggesting the presence of chromite, could be obtained from the black mineral. Baker, who describes the petrography and chemistry of the serpentine, obtained 6.72 per cent. of Cr_2O_3. This percentage is rather high for the rock as a whole, since a composite sample consisting of numerous pieces of serpentine from various parts of the outcrop, yielded on analysis[1] 2.75 per cent. of Cr_2O_3 and no platinum. This percentage of chromium

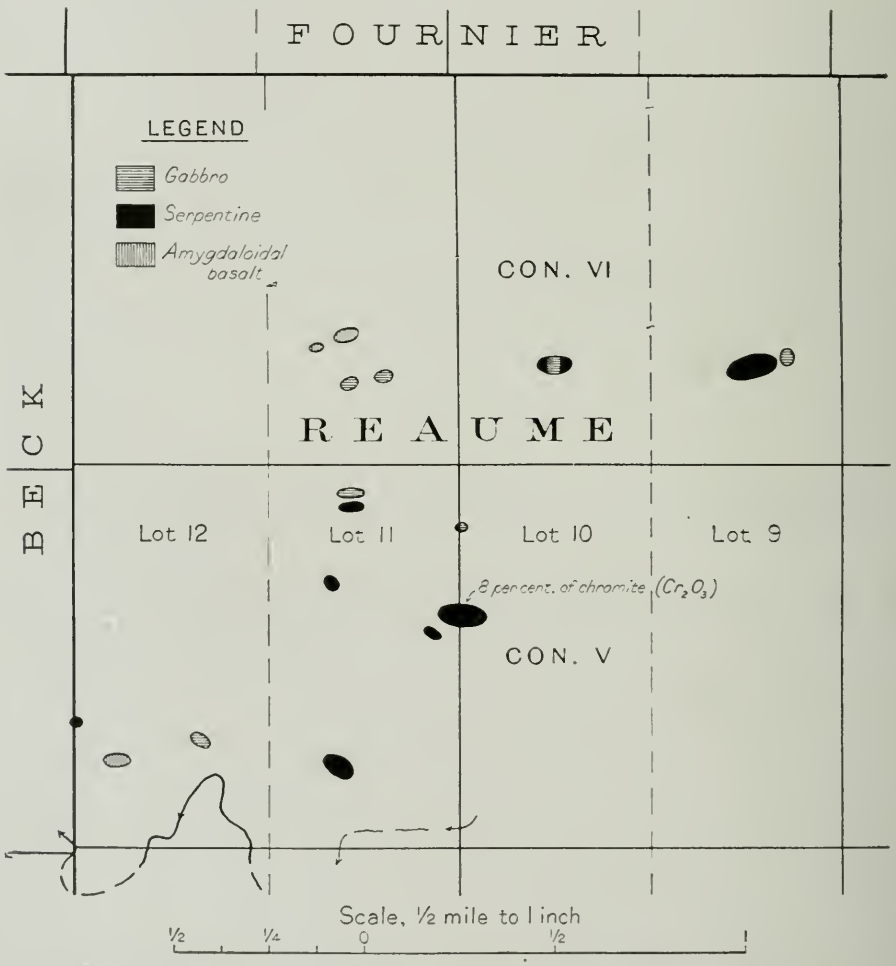


Fig. 7—Sketch map showing rock outcrops in the northwest portion of Reaume township.

is much too low to be of economic value. However, it might be advisable to trench along the borders of the serpentine mass in the hope of locating lenses of ore, as chromite often occurs at the contact.

Chromium was also detected in a sample of serpentine which was sent to the Bureau of Mines by William Campbell of Low Bush from a point on Lower Abitibi lake about four miles southeast of the outlet of Abitibi river. The sample

[1] Analysis by W. K. McNeill, Provincial Assayer.

resembled the serpentine previously described, and was found to contain[1] 0.82 per cent. of Cr_2O_3, no platinum and no nickel.

Serpentine occurs in various parts of northeastern Ontario,[2] some outcrops of which contain economic deposits of nickel-copper ore,[3] and asbestos,[4] while others contain chromium, platinum, and microscopic diamonds,[5] but not in commercial quantity. Certain of these outcrops are worthy of further prospecting for these minerals, especially for chromite, since practically all the chromite deposits of the world occur in serpentine and sands resulting from the disintegration of this rock. It is not likely that a large body of disintegrated serpentine will be found in Ontario owing to the country having been glaciated. Reaume township is one of the best known places in Ontario to prospect for chrome ore. The mineral occurrences have already been described; the accompanying sketch map, (fig. 7), may be of value to anyone wishing to prospect this locality. A small body of chromiferous serpentine carrying about 8 per cent. of Cr_2O_3 occurs on the line between lots 10 and 11, concession V, and approximately 33 chains south from the south boundary of concession VI, Reaume township. Much drift[6] occurs in the area, but by further trenching workable deposits of chromite might be found.

Early in 1918 D. O'Connor discovered chromite in the north part of lot 2, concession I, Dundonald township. The chromite occurs finely disseminated through serpentine. A sample assayed 1.34 per cent. of chromium.

The chief sources of chromite in the world and the most recent returns of production[7] are:—

	Year.	Production.
British Empire:		
India	1915	3,767 tons.
Rhodesia	1916	88,871 "
Canada[8]	1916	27,030 short tons.
Australia (N.S.W.)	1916	450 tons.
Other Countries:		
Asiatic Turkey	1909	11,364 metric tons.
New Caledonia	1916	74,115 " "
Bosnia-Herzegovina	1913	305 " "
Greece	1914	7,059 " "
Russia	1912	21,277 " "
United States	1916	40,000 tons (gross).
Japan	1911	1,527 metric tons.

The demand and prices for chromite have advanced in late years. The prevailing prices are very satisfactory, and in the latter part of 1916 the scale in force for Quebec chromite[9] f.o.b. Quebec Central Railway's stations was: 50

[1] Analysis by W. K. McNeill, Provincial Assayer.

[2] Some of these exposures are referred to by M. B. Baker, Ont. Bur. Mines Report, 1917, Vol. XXVI, pp. 270-2.

[3] Since 1912 the Alexo mine has been shipping ore which will average 4.90 per cent. of nickel and 0.60 per cent. of copper, according to the Report of the Royal Ontario Nickel Commission.

[4] During parts of 1916 and 1917 asbestos was shipped from the Porcupine area.—Ont. Bur. Mines Report, 1917, Vol. XXVI, pp. 108 and 273-4.

[5] Ont. Bur. Mines Report, 1914, Vol. XXIII, pp. 47-8.

[6] E. D. Bolton surveyed Reaume township in 1907 and reported seeing no rock in place; however, he remarked on the great irregularity in the magnetic variation of the compass, especially crossing lots 8 and 9, concessions V and VI.

[7] Department of Scientific and Industrial Research, Advisory Council, London, Eng., 1918.

[8] Canada's chrome ore comes from the Coleraine and Black Lake districts, Quebec, which produced 35,726 short tons, valued at $495,981 in 1917.

[9] Canadian Mining Journal, Mar. 15th, 1917, p. 121.

per cent. ore, $45 a ton; 40 per cent. ore, $38.75; 30 per cent. ore, $32.50; 25 per cent. ore, $18. For special purposes ore higher than 50 per cent. can be marketed at $1.00 a unit. Ore containing as low as 12 per cent. of Cr_2O_3 is being concentrated by two mills at Black Lake, Quebec.

In April, 1918, California chromite was offered at $1.40 to $1.60 per unit f.o.b. shipping points, this being for ore running 45 per cent. chromic oxide.

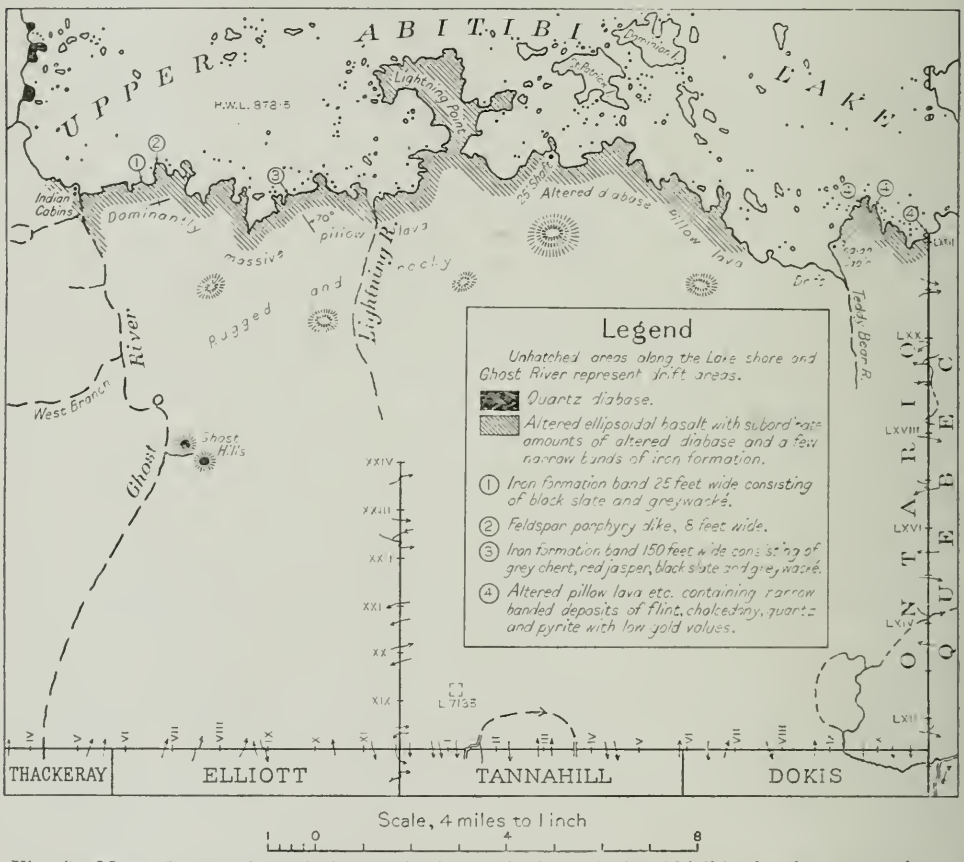


Fig. 8—Map of a portion of the south shore of Upper Lake Abitibi, showing approximate location of the original gold discovery claim, L 7135, north of the township of Tannahill.

Pyrite

On the southwestern edge of the serpentine mass referred to in lot 4, concession C, Steele township, is an iron pyrites deposit upon which some work has been done. The richest portion of the deposit is reported to be covered by water at present, Abitibi lake having been raised 9 feet by the building of a temporary dam at Couchiching falls. Mr. William Campbell, Low Bush P.O., Ont., who is a part owner, stated that the pyrites is practically pure over a width of 8 feet and for a considerable length. On the shore can be seen much gossan and considerable pyrite disseminated through a graphitic schist, the occurrences being almost identical with a pyrite deposit in lot 7, concession VI, McCart township.[1]

[1] Ont. Bur. Mines Report, 1917, Vol. XXVI, pp. 271-272.

Gold

On Abitibi Lake

During 1906 and 1907 numerous claims were staked for gold on the shore and islands of the Upper and Lower Abitibi lakes and considerable work done on some of them. The deposits are described by W. G. Miller[1] and M. B. Baker.[2] Four types of auriferous quartz veins may be mentioned, namely: (1) veins in the Keewatin greenstones; (2) veins in the Keewatin rusty-weathering dolomites; (3) veins in Algoman (?) granite, and (4) veins in quartz diabase, probably of pre-Algoman or Keweenawan age. The last type, which is the most promising, is represented by the Shaft or Gold island deposit (fig. 9). No work has been done on the property, however, since 1907, when a shaft 75 feet in depth was sunk on a narrow vein carrying considerable visible gold. The deposits on the shores of Upper Abitibi lake between Teddy Bear or Mattawasagi river and the interprovincial boundary (see fig. 8) are narrow, and consist of banded chert, chalcedony, red jasper and quartz, thus somewhat resembling a banded Iron formation. Much pyrite and some limonite are present, and low values in gold may be obtained on assaying.

On Patten River

In 1913 gold was reported to have been found at the 30-foot falls near the mouth of Patten[3] river which is about two miles west of mileage 126 on the interprovincial boundary. Several claims were staked and some surface prospecting done. The rock in the vicinity is an altered quartz gabbro, which looks fresher than the Keewatin and older than the Keweenawan. The quartz veins are narrow, usually under six inches in width, and contain pyrite, calcite and occasionally low gold values. The vein on the last portage at the 30-foot falls was reported to contain some visible gold. The deposits appear to be of no economic importance. However, they are of interest in that they represent another locality in Ontario where gold has been found.

The locality is reached from La Reine station, Quebec, by the Okikodosik and Patten rivers. A track survey was made of these waters by T. J. Patten, O.L.S., in 1906 in conjunction with his survey of the interprovincial boundary. The writer on his trip last autumn found only slight alterations were necessary in the plan of Patten's track-survey, and has shown the rock outcrops on the accompanying map.

No pillow lavas were seen on the route; however, some of the hornblende and chlorite schist may represent altered volcanic flows, while others may be the basic parts of the Laurentian. Some of the granite gneisses appear to be typical Laurentian rocks, while the massive, fresh-looking granites resemble the Algoman granites.

[1] Ont. Bur. Mines Report, 1907, Vol. XVI, pp. 219-220.
[2] Ont. Bur. Mines Report, 1909, Vol. XVIII, pp. 268-271.
[3] Previously known as Woman river.

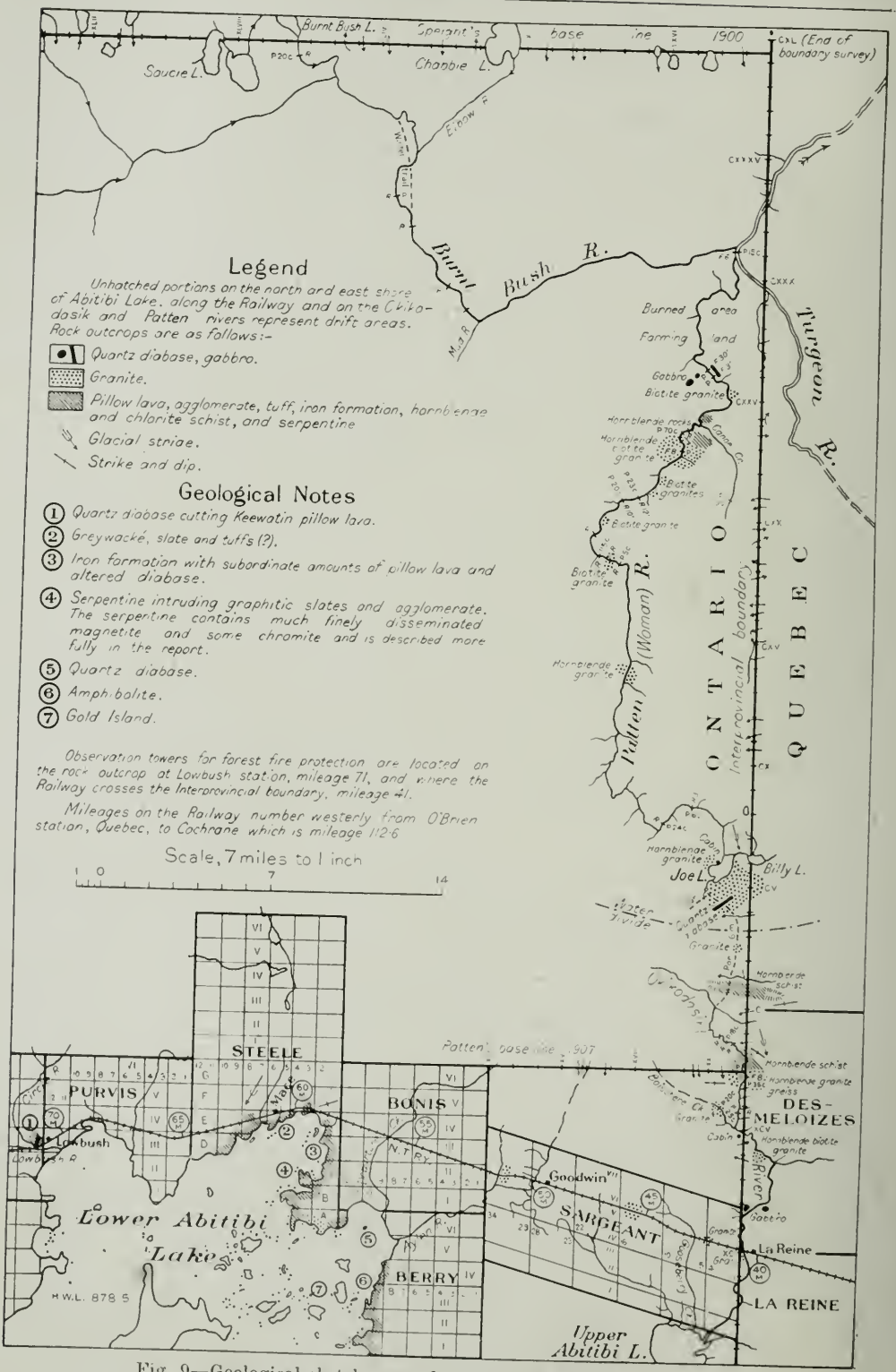


Fig. 9—Geological sketch map of part of the Abitibi Lake area.

In Rickard Township

Rickard township is situated 10 miles west of Abitibi lake and can be reached by the Abitibi river as shown on Fig. 10. The banks of the river from Abitibi lake to Couchiching falls, a distance of 5 miles, are low and free from rock exposures, but from Couchiching falls to Twin falls (which is situated to the west of Rickard township), a distance of 20 miles, the river has eroded the channel to a depth of 50 to 100 feet below the general land level, and occasionally rock outcrops may be seen. The rocks at Couchiching falls are pillow lavas intruded by numerous narrow quartz diabase dikes. One and one-half miles below, at Little Couchiching falls, in lot 2, concession IV, Knox township, is a greyish-green carbonate schist with large grains of quartz, representing probably an altered quartz porphyry. Seven or eight outcrops of altered ellipsoidal basalt may be seen between Little Couchiching and the west side of Rickard township. On account of the proposed development of Twin falls which will maintain the

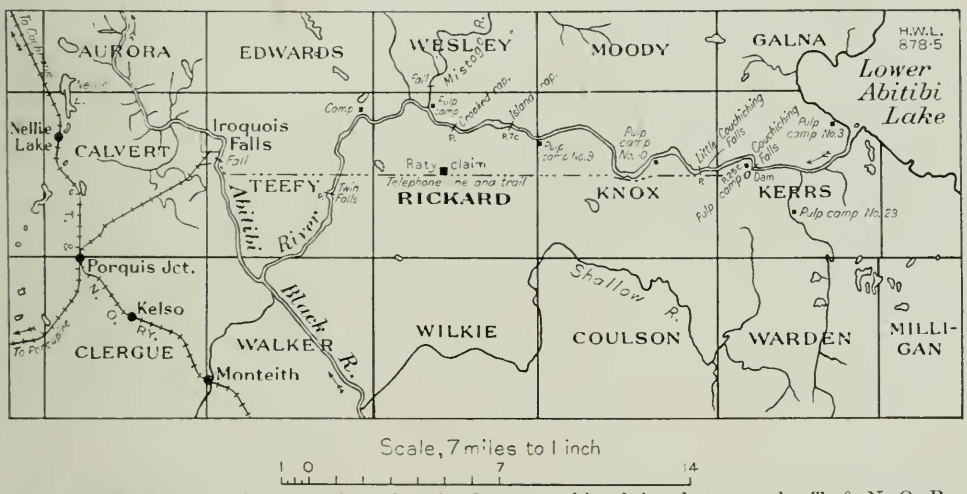


Fig. 10—Sketch map showing Rickard and other townships lying between the T. & N. O. Ry. and Lake Abitibi.

river above the dam at the level of Lake Abitibi, thus drowning out Couchiching falls, the timber along the river has been cleared away on each side, to make a wider water channel for the towing down of pulpwood. Much of Rickard township will be flooded, as shown by fig. 11.

In July, 1917, gold was found on the southwest quarter of the south half of lot 7, concession IV of the township. The discovery was made by a Finn named John Raty at a point 200 yards from a telephone line which runs from Iroquois falls to Couchiching falls on the Abitibi river and had been travelled for some years by the officials of the Abitibi Pulp and Power Company. Shortly after the discovery, representatives of two mining companies sampled the vein, but obtained low values. Later, in sinking, the prospector found a rich gold showing at a depth of five feet, which resulted in the Mining Corporation of Canada securing a working option. At present, April 1918, the shaft is 100 feet in depth at which level some drifting has been done. Some very rich samples have been obtained.

The country is undulating, and superficial deposits consist of stratified clay, through which occasional rocks rise as high as 100 feet above the stream valleys. Much of the forest in this area was destroyed by the big fire in 1916.

Only a cursory examination has been made by explorers of the geology along the canoe routes, with the exception of J. G. McMillan's exploratory trips across Rickard and surrounding townships in 1904.[1] The rocks are pre-Cambrian, consisting of Keewatin pillow-lava schist (meta-basalt), with subordinate areas of altered diabase and cherty Iron formation, all of which have been intruded by narrow dikes of feldspar porphyry and quartz-diabase, probably of Algoman

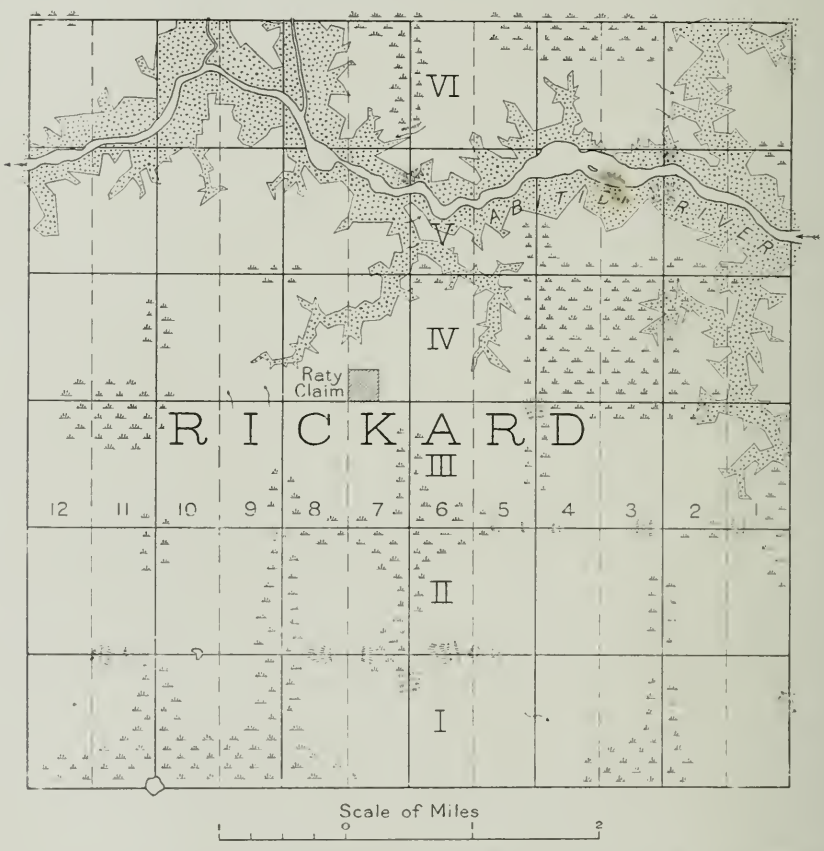


Fig. 11—Rickard township, showing location of the Raty gold discovery. The stippled area will be flooded as a result of the power development at Twin Falls.

and Keweenawan age respectively. The greenstones are in places altered to carbonate schists. The quartz-diabase appears to be similar, both megascopically and microscopically, to the Nipissing diabase at Cobalt, but its age cannot be definitely stated. A few narrow dikes of porphyry from two to ten feet in width intrude the greenstones on the Raty claim. About one-half the rock is composed of somewhat rounded phenocrysts of pinkish feldspars with some hornblende and quartz. Under the microscope many of the feldspars are seen to have a zonal struc-

[1] Ont. Bur. Mines Report, 1905, Vol. XIV, pp. 184-212.

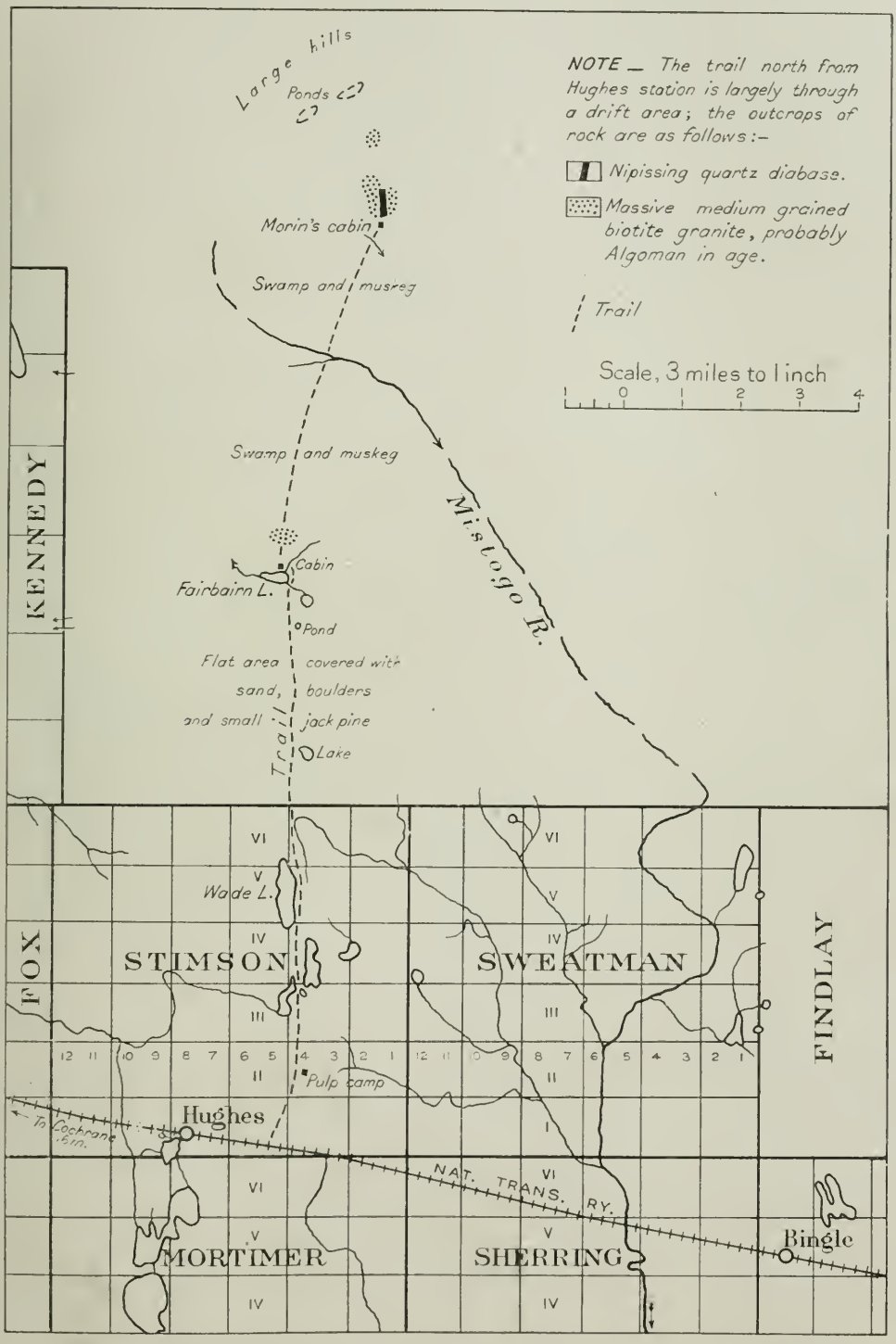


Fig. 12—Sketch map of a portion of the unsurveyed area north of Hughes Station, N. T. C. Ry.

ture, there being an occasional albite phenocryst. The hornblende phenocrysts are partly altered to chlorite. The groundmass is microcrystalline, and consists of hornblende, chlorite, plagioclase feldspar, quartz and apatite.

Gold was first found near the centre of the claim in a three-inch quartz vein striking east and west in a rusty weathered carbonate schist. The main deposit, however, is on the north part of the claim, and strikes east and west for at least 600 feet. The vein averages about six feet in width and dips almost vertically. Quartz, the chief gangue mineral, has a milky appearance. Calcite occurs as a replacement mineral in the wall rock rather than in the vein itself. Talc and sericite are frequently met with, while feldspar is not so prominent. Next to quartz pyrite is the most abundant vein mineral, there being also small quantities of copper pyrites, galena, and molybdenite. Molybdic oxide and native copper are secondary minerals near the surface. The gold, which is extremely coarse in places and varies in colour from light to dark yellow, occurs in crushed dark portions of the quartz with tellurides and other minerals, the gold usually crystallizing out after the tellurides. In the samples examined two tellurides have been identified, viz.: tetradymite (bismuth telluride) and altaite (lead telluride). A silver telluride may be present, as considerable silver was found on analysis. The values disappeared at a vertical depth of 40 feet. The magmatic waters connected with the porphyry intrusions may have had much to do with the ore deposition. The wall rock of the main vein is now a carbonate schist originating probably from a diabase. A small steam plant is in operation and diamond-drilling is being done.

Near Lightning River

A gold find was made by L. B. Howey, M. R. Howey, and W. M. Cochenour south of the Lightning river in the autumn of 1917, which resulted in a considerable number of mining claims being staked. The discovery claim, L. 7135, in the recently-named township of Holloway, which is shown in fig. 8, lies approximately one and three-quarter miles northeast of the northeast corner of Elliot township. Messrs. G. Young and S. Cragg, who have optioned the claim, state that gold values up to $40 to the ton were obtained from samples, and that the vein is about one foot in width, 200 feet long and dips about 25° from the horizontal.

Silver

A trip was made from Hughes station, N. T. C. railway, into the unsurveyed territory 16 miles to the north, where silver was reported to have been found by J. Morin. The trail is over sand plains, swamp and muskeg as shown on fig. 12. On the trail to the north of Fairbairn lake is a small outcrop of massive, pink, medium-grained, biotite granite. Similar rock occurs on Morin's claim, which in addition is cut by a quartz-diabase dike, 60 feet wide and probably of Keweenawan age. In the diabase and running in the direction of the dike for about 200 feet, is a quartz-calcite vein from a few inches to one foot in width, which contains small quantities of chlorite, pyrite, galena and copper pyrites. A few samples from the vein yielded on assay 3 ounces of silver to the ton and no gold.

THE MATACHEWAN GOLD AREA

By A. G. Burrows

Introduction

In the fall of 1916 a discovery of gold was made on the Davidson claims in Powell township, which is on the Montreal river, in the District of Timiskaming. Powell township is near Fort Matachewan, a Hudson's Bay Company post, consequently the area has become known as the "Matachewan Gold Area." Prospecting had been carried on from time to time since the discovery, in 1906, of silver in James township, at Elk Lake. Gold was found at several places in the southeast part of Alma township and in the north central part of Cairo township, in an area of syenite, a few years previous to the discovery in Powell.

At the Davidson claims in Powell township the original discovery was native gold in an irregular mass of quartz and rusty weathered schist. In 1917 gold was

Fig. 1.—Scene on the Montreal river, north of the mouth of the East Branch (looking north).

found in a reddish porphyry by Sam Otisse on his own claims to the northeast of the Davidson. This prospector also discovered gold in a band of grey pyritous schist which lies to the south of the porphyry. Further work on the Davidson claims resulted in gold being found in the red porphyry which outcrops on these claims.

Since there was no detailed geological map of this area, the writer was instructed by Dr. W. G. Miller, Provincial Geologist, to make an examination of the country in the vicinity of the "finds." It was found that while a number of claims had been staked the previous winter, work was being done on only a few of these, consequently only a very small part of the new staking has been well prospected.

A geological knowledge of the area was obtained by travelling the township boundaries, traversing most of the water routes, and making sections away from

the water routes. Only a few of the claim lines in the vicinity of the Davidson find were travelled, since most of the claims were very irregularly staked in the winter and difficult to follow in the thick bush in summer. However, a general examination was made of Powell, Cairo, Baden and Alma and the Matachewan Indian Reserve, while portions of the north parts of Yarrow and Kimberley also received attention.

During the season of 1917, Dr. H. C. Cooke, of the Dominion Geological Survey, examined an extensive area to the west of the Matachewan area, and his map of this country, showing the geology and canoe routes, will be of great assistance to the prospectors working westerly from the Montreal river.

Fig. 2.—Davidson camp. The discoverer of gold on the Davidson, Jake Davidson, is the second figure from the left.

Ingress to the Area

The nearest railway station is Elk Lake, the terminus of a branch line of the Timiskaming and Northern Ontario railway that leaves the main line at Earlton station.

From Elk Lake there is a canoe route up the Montreal river a distance of about 30 miles to the Davidson landing. In high water in spring a gasoline boat has been utilized as far as the foot of the Long portage, with a short portage around Indian Chute. The trip by canoe alone is very arduous, owing to the swift current in the Montreal river above Indian Chute. In this trip three portages are necessary. In low water during the summer all the stiff rapids above Indian Chute are usually poled or tracked.

A route from Elk lake, by way of Long Point lake, was used by various parties in 1917. This requires transportation of supplies and canoes over the Gowganda wagon road to Long Point lake, from which there is a water route down stream by way of the East Branch of the Montreal river to the Matachewan area. Supplies for operations in 1918 were taken in (from Elk Lake railway station) over a winter road that roughly follows the Montreal river.

Early References to the Area

In 1875 Robt. Bell, of the Canadian Geological Survey, made an exploration survey of a route from Lake Huron to James Bay.[1] In his report he describes the east and west branches of the Montreal river, which flow through the Matachewan area. The geology is of necessity very briefly described, but reference is made to the conglomerate and other rocks along the route. The igneous rocks are for the most part called diorite, a general term for the basalt, diabases and other rocks in the complex of basic igneous rocks. Bell describes a quartz vein containing specular iron ore, along the east branch, about ten miles south of the junction with the main Montreal river.

In the Report of Survey and Exploration of Northern Ontario, 1900, J. L. R. Parsons,[2] geologist with Exploration Survey Party No. 3, gives a brief description of the geology along the Montreal river where it traverses the Matachewan area. He obtained low values in gold from two samples of quartz and pyrite in veins near the first rapid below Fort Matachewan.

In 1903 G. F. Kay made an examination of an area to the southwest of Lake Abitibi. His report has a description of a canoe route from the Black river to Fort Matachewan. Part of this route is shown in the northeast portion of the accompanying geological map of the Matachewan gold area. Microscopical descriptions of rocks occurring on Turtle, Separation and other lakes in the Indian Reserve or in Alma township, are given in Mr. Kay's report.[3]

In 1911, the Bureau of Mines, Ontario, published a sketch map, by W. M. Goodwin, showing part of the geology of the area between Porcupine and Gowganda. On this map the geology of part of the west portions of Powell and Baden townships is given.

In 1914, P. E. Hopkins, of the staff of the Bureau of Mines, examined claims in Yarrow township, on which iron ore was reported, and also some fluorite and barite veins in Cairo township. His notes on these occurrences are referred to later in the report.

Topography

The country described in the report is near the height of land separating the waters flowing to James Bay from those flowing to the St. Lawrence river. A portage at the north end of Matachewan lake crosses the divide between these waters. The area is of the rocky lake type, but much of the rock is concealed by a

[1] Geological Survey of Canada, 1875-6; Report of an Exploration in 1875 between James Bay and Lakes Superior and Huron, p. 301.

[2] Report of Survey and Exploration of Northern Ontario, p. 111.

[3] The Abitibi Region. Ont. Bur. Min., 1904, Vol. XIII, p. 112.

thin covering of soil. Where not recently burned over, there is a very heavy growth of medium sized timber. The topography is quite rugged in parts, some hills reaching 200 feet above the plain. Changes of elevation of 50 to 100 feet are frequent. Conspicuous hills can be observed near the north end of Matachewan lake. These are of greyish andesitic rock intruded by fresh-looking diabase. On the west side of Mistinigon lake there are high ridges of quartzite and conglomerate of the Cobalt series. Matachewan lake from its north end to Fort Matachewan is simply a long narrow sheet of water with precipitous shores on either side. The portion of the Montreal river above the Long Rapids in Kimberley township consists of a series of lake expansions with high shores and connected by short flat rapids.

Fig. 3.—One of several large pot-holes at the mouth of Davidson creek.

An interesting feature relating to the physiographic history of the area has been the diversion of the west branch of the Montreal river from its former to its present course. At one time the river flowed easterly from a point one and a half miles north of the south boundary of Powell, through what are now the Davidson claims, and emptied into the Montreal river a mile north of the junction with the East branch. The ancient channel followed for three-quarters of the distance the course of Davidson creek shown on the map. From a small pond at the end of the small stream flowing to Davidson creek there is a depression for three-quarters of a mile to the present West branch. The divide between this pond and the West branch is seventeen feet above the latter, in low water, as determined by Sutcliffe and Neelands in their hydro-electric survey of Matachewan or Big Bend falls. At

the west end of the pond there is a large dry pot-hole in the greywacké slate formation, and also a large cavern-like basin in the pond itself which had been formed by the cutting action of a strong eddy in the old river. For a half mile along Davidson creek, near Davidson camp, there is an accumulation of huge boulders along the bed of the old stream, while near Davidson's landing, at the mouth of the creek, there are numerous large pot-holes in the Keewatin rocks. Some of these pot-holes are shown in the accompanying illustrations. The West branch empties into Lake Matachewan at Matachewan falls, where there is a drop of 41 feet in 600 feet. The diversion of the river from its former course has been quite recent, geologically speaking, since the falls have been carried back only a short distance from the lake, with practically no gorge. There are two small rapids above the falls and below Mistinigon lake, and it is probable that formerly this

Fig. 4.—Cavern-like basin at the head of the north branch of Davidson creek. At one time this was probably part of the old course of the west branch of the Montreal river.

lake was a long narrow body of water closed at its north end, and discharging easterly from opposite the big island.

The old course of the West branch followed a depression between the older Keewatin series and the later sedimentary rocks of the Cobalt series, as shown on the accompanying geological map.

Timber

This area has been burned over several times in the history of the Hudson's Bay Company at Fort Matachewan. Charred stubs of large pine trees are frequently observed throughout the green forest. The present timber is suitable for

pulpwood, railway ties and local building purposes. It consists of the common trees of northern Ontario, spruce, jackpine, balsam, birch, poplar and cedar. Along the east shore of the Montreal river, from the East branch to the north end of Matachewan lake, there are small groves of red and white pine, which represent the northerly limit in northern Ontario for these trees.

The greater part of Cairo township has been burned over recently, exposing rolling sand plains and areas of rocky ridges burned off clean. A stretch across the southerly part of Powell township was burned over in 1916.

Fig 5.—Fort Matachewan. Steve Lafricain, for many years in charge of the Hudson's Bay Co. post at Fort Matachewan, is the second figure from the left.

Agriculture

The area is not suitable for agricultural purposes, except in small patches. Most of the soil is gravelly and sandy, and there are wide stretches of clean sand with small jackpine. Small areas have been cleared by the Indians in the Indian Reserve, and there is a vegetable garden at Fort Matachewan. Fine potatoes, turnips and cabbages are grown at these places.

Geology

The compact rocks are all referred to the pre-Cambrian. The following legend shows a classification of the rocks in the probable order of geological succession, from the Pleistocene to the Keewatin.

PLEISTOCENE—
GLACIAL AND RECENT .....Sand and gravel.

PRE-CAMBRIAN—
ANIMIKIAN (Cobalt series) ...Conglomerate, quartzite, slate-like greywacké.

(Unconformity)

ALGOMAN? .....Granite, syenite, porphyry, diorite, diabase.

(Intrusive contact)

LAURENTIAN? ..... Granite, gneiss.

(Intrusive contact)

KEEWATIN .....Greenstone (pillow lava), meta-basalt, andesite, old diabases, serpentine, felsite, volcanic fragmental, Iron formation, conglomerate.

INTRUSIVE ROCKS .....Diabase.

The oldest rocks of the area are of Keewatin age and consist mostly of basic to intermediate volcanics, accompanied by chert (Iron formation) and schistose sedimentary rocks like quartzite and conglomerate. These have been intruded by numerous diabase and porphyrytic dikes, whose age, beyond that they are younger than the Keewatin schists, is difficult to determine.

The older rocks have also been intruded by acid rocks like granite, syenite, gneiss and porphyry, which are probably of Laurentian or Algoman age. These acid rocks have also been intruded by numerous dikes of diabase, some quite fresh-looking.

A series of flat-lying sediments of the Cobalt series has been deposited on the eroded surface of the older greenstones, granites, syenite, porphyry, and some of the diabase dikes.

At only one place was a diabase dike observed intruding the Cobalt series, but a few others have been reported. This is in marked contrast to the older rocks, which are everywhere intruded by numerous dikes of diabase, consequently most of these dikes would appear to be older than the Cobalt series. In addition, at several points unconformities between the Cobalt series of sediments and diabase dikes have been noted. It would therefore seem that the conglomerate in the area would not be worth prospecting for silver, owing to the scarcity of sills and dikes of diabase of Keweenawan age.

Keewatin

The Keewatin is represented by altered lavas, meta-basalt, andesite, porphyry, diabase, serpentine, carbonate rocks, Iron formation, quartzite, conglomerate, etc. These rocks are for the greater part much altered, and many are now schists. Where schistose the general strike is approximately northeast and southwest.

Both amygdaloidal and ellipsoidal lavas occur in parts of the area, but most of the greenstone type of rock is fine-grained, dark-coloured meta-basalt. Fine-grained blackish rock can be well observed in the Keewatin area east of Whiskey Jack creek, in Cairo township. Here the ferromagnesian mineral has been altered to chlorite, but laths of plagioclase are well preserved, with extension angles near oligoclase-andesine. Secondary feldspar, mica and quartz are present, also numerous grains of magnetite, altering to leucoxene.

Excellent exposures of pillow lava occur to the south of St. Paul lake and on mining claim HF 13, west of Fox rapids. In the latter place there are also numerous amygdules in the altered lava. The pillow lava, east of the road from Fox rapids, is associated with bands of volcanic fragmental, of fine-grained and agglomeratic character, and some cherty Iron formation.

Light coloured felsite occurs with the pillow lava and Iron formation on claims HF 13 and 12502, west of Fox rapids. In hand specimens the rock is quite fine-grained, but under the microscope occasional small phenocrysts of feldspar are seen. The rock is crushed, and contains numerous minute veinlets of secondary quartz. The siliceous iron formation is in bands, and several pits have been sunk on it where there is an oxidized surface from the weathering of iron pyrites. These different rocks are intruded by dikes of diabase, and thin remnants of basal conglomerate of the Cobalt series overlie unconformably this complex.

Rocks north of Davidson Creek.—The Keewatin rocks in Powell township that are exposed to the north of Davidson creek are greatly altered to schists. Some of the green and grey schists are probably derived from igneous rocks of basic to intermediate composition. Other schists are highly oxidized at the surface and show no indication of their origin. While rusty-weathering, below this oxidation they are light grey in colour, and contain quartz, carbonate, sericite and iron pyrites. On the Otisse claims, 5379 and 5380, this grey rock has been found to be gold-bearing, and it may prove of economic value as a gold deposit.

On mining claims 5387 and 5390, and adjacent claims, extremely altered volcanic rocks, some of which are fragmental, are recognized. They are cut by numerous whitish-weathering feldspar-porphyry dikes and diabase. The older rocks and the porphyry dikes contain quartz veinlets in places, and low values in gold are sometimes obtained. One of the porphyry dikes occurs on the trail 30 chains west of the Montreal river; another on the creek south of a small lake on claim 5402. A greyish porphyry dike with quartz veinlets is seen 12 chains northwest of number two post of claim 5385. These dikes belong to an older series than the orthoclase porphyry on the Davidson and Otisse claims, and are probably associated with the Keewatin rocks. Similar dikes occur in other parts of the area, but they do not appear to be of economic importance.

Sedimentary Rocks.—Schistose sedimentary rocks are seen on the east shore of Mistinigon lake about one and a half miles north of the south boundary of Powell and on the north side of the trail leading to the Davidson claims. The rocks are in vertical attitude and strike N. 60° E. They can be traced easterly in the township to beyond Otisse lake, and consist of coarse material resembling conglomerate, and finer material like greywacké. The inclusions in the conglomerate rock are mostly small fragments of rocks of obscure origin, whitish porphyry, felsite, etc. A sample of the greywacké material from 15 chains north of No. 1 post, claim 5375, examined in thin section, contains numerous fragments of feldspar and quartz and bits of rocks, in a fine groundmass. This rock is best preserved on the north shore of Otisse lake. Small porphyry dikes, altered dikes of basic igneous rock, and numerous diabase dikes, interrupt the continuity of these bands across country. No

relationship was observed between these schistose sedimentary rocks and the schistose altered igneous rocks to the south, consequently it is thought advisable to group them with the Keewatin, of which they appear to form a part.

However, the possibility of these sediments being a remnant of the Timiskaming series, folded with the Keewatin, must be considered. This area lies midway between Midlothian township, where J. G. McMillan[1] recognized a wide area of Timiskaming, and the Kirkland Lake area, where this series occurs in large volume.

Light-coloured Porphyritic Rocks.—There are a number of light grey-coloured porphyritic rocks which are associated with the dark, very basic Keewatin greenstones, that are also probably altered volcanics, since these occur in larger volume than is generally seen in the porphyritic dikes. These rocks are prevalent in parts of the Indian reserve, especially on Turtle lake, and around Matachewan lake above Matachewan falls. Feldspar phenocrysts can often be observed in hand specimens. A sample from the east expansion of Turtle lake shows altered plagioclase phenocrysts, in a groundmass of hornblende needles, biotite, zoisite, feldspar, and quartz. There are also rounded areas of fine-grained secondary quartz. Some of the rock is crushed and mashed to resemble a conglomerate, but is an autoclastic. Volcanic fragmental material occurs on the north line of Alma township to the west of the two-mile post, and on part of the shores of Alma lake. Along with the altered igneous rock in the northeast part of Alma there are bands of slate-like rock, greatly metamorphosed, and belonging to the Keewatin complex. Owing to the intermingling of the sedimentary with the igneous metamorphosed rocks, it would be difficult to separate them.

To the south of the narrows at the south end of the upper part of Lake Matachewan there is a greyish porphyritic rock, which under the microscope proves to be an andesite or porphyrite. Phenocrysts of plagioclase (oligoclase or andesine) and hornblende (actinolite) are abundant, while these are surrounded by small rods of feldspar in a dense groundmass in which hornblende can be recognized. Rocks of somewhat similar appearance occur on both sides of the lake inland, so that the volcanic rock is widespread and is probably an old lava flow rather than an intrusive.

An analysis of the grey porphyritic rock by W. K. McNeill, Provincial Assayer, shows the following percentage composition: Silica 59.06, alumina 14.39, ferrous oxide 5.80, ferric oxide, 2.14, lime 6.98, magnesia 5.11, soda 2.75, potash 1.20, water 2.31, carbon dioxide 0.44.

Serpentine.—There is an exposure of serpentine on a small island near the west shore of Mistinigon lake, one-half mile north of Bell island. The rock contains minute veinlets of asbestos. Serpentine also occurs at points on the east shore where there is a large proportion of carbonate, the surface of the rock being altered to a rusty brown colour. The rock also contains a number of white calcite veins.

[1] T. & N. O. Railway map of part of area between Gowganda and Porcupine, 1911.

One mile northeast of Fox rapids, there is a mass of serpentine on the west side of Whiskey Jack creek. Here a pit has been sunk, but no asbestos or chrome ore was observed in the material on the dump. Just south of the pit there is a mixture of serpentine and carbonate rock in bands that are much contorted, with a rough honeycombed surface where the lime rock has been leached out.

Diabase in Keewatin.—In the areas of Keewatin, particularly in Powell and Baden townships, there is an abundance of diabase with the older rocks. This diabase has not been separated on the map from the older rocks. The occurrence is similar to that in other Keewatin areas, as in Maisonville and Munro townships, where diabase occurs in large volume with the greenstones and other rocks. The age of this diabase is unknown, but its freshness under the microscope suggests that it is much younger than the greatly altered Keewatin. Since the Timiskaming series in neighbouring areas, *e.g.*, Kirkland Lake area, is also schistose like the Keewatin, it is probable that the diabase is also younger than this series and consequently post-Timiskaming.

A specimen of quartz diabase from a ridge just south of the 2nd mile post on the north boundary of Powell township is quite fresh under the microscope. It contains laths of plagioclase and augite, some of the latter showing twinning. Quartz is present in numerous grains: a small quantity of magnetite occurs in the specimen.

Granite and Gneiss (Laurentian?)

There are exposures of granite and gneiss along the Montreal river from a short distance below Fox rapids to the foot of the Long Portage. Similar rocks occur along the north boundary of Kimberley between the crossings of the Montreal river. The two rocks, reddish granite and dark grey to black glistening hornblende gneiss, are intermingled, and are similar to rocks that in areas farther south have been referred to the Laurentian.

Granite and Diorite (Algoman?)

There are two small areas of reddish hornblende granite in the north part of Powell township. There is another small area in the northwest part of Baden township, and a larger area of granite and quartz diorite in the northeast part of Baden and the northwest part of the Indian reserve. The granite is pinkish in colour, and the diorite is a grey coarse-grained rock in which the feldspars are mostly plagioclase, the other constituents being orthoclase, quartz, hornblende and biotite.

Very small outcrops of granite occur in the northeast part of Alma township. The exact age of these isolated areas of granite is not known. They are all quite fresh and massive, and intrude the Keewatin. They are probably of Algoman age, like similar rocks in the Kirkland lake and Cobalt areas, that are younger than rocks of the Timiskaming series.

Syenite (Algoman?)

There is a batholith of syenite which extends across parts of Cairo and Alma townships into Holmes and Flavelle townships to the east. It has a width across

Cairo and Alma of five miles. Here and there it is intruded by fine-grained reddish acid dikes and also by dikes of diabase.

The rock is generally of a rich red colour in fresh material, and varies greatly in crystallization, often showing lathlike porphyritic crystals of feldspar one-half an inch in length. There is usually only a very small percentage of hornblende and quartz in the rock.

A specimen from the Brookbank claim, in the southeast part of Alma, is a quartz hornblende syenite, composed largely of red feldspar showing a somewhat perthitic intergrowth in the crystals. Magnetite and apatite are accessory minerals.

A specimen from the Chief claim, also in the southeast part of Alma, is similar in its feldspar, but contains only a little chlorite as the ferromagnesian mineral.

A sample of syenite from the Biederman claim (16042) on Browning lake was analyzed by W. K. McNeill for its alkali content and contains 9.05 per cent. of potash and 2.95 per cent. of soda, showing that most of the feldspar is orthoclase. The high percentage of potash in the syenite is worthy of note, being about three-quarters as much as that contained in the orthoclase feldspar at the well-known Richardson feldspar mine in Frontenac county, on which experimental work has been done for the production of soluble alkalies, in aid of the fertilizer industry. It may be that at some future time this large deposit of syenite will be of value as a source of potash.

The syenite is an important formation, since several gold-bearing veins have been located in it, and while no economic deposits are yet proven, the area is worthy of careful prospecting. In the same rock veins of barite and fluorite have also been discovered.

The syenite is intrusive into the Keewatin, but underlies unconformably the conglomerate of the Cobalt series.

The erosion of the syenite batholith took place largely before the deposition of the rocks of the Cobalt series, since a considerable area of conglomerate lies unconformably on the syenite in Cairo township.

Relationship Between Syenite and Granite-Gneiss.—The relationship of the syenite to the granite and gneiss in the southeast part of Cairo is not known, but the syenite is believed to be the younger rock, since it shows no gneissic structures, and is probably of Algoman age. There are a number of syenites, granites and porphyries in northern Ontario with which gold-bearing quartz veins are associated, and these are considered to be post-Timiskaming intrusives, following the irruption of which there was gold mineralization.

Orthoclase Porphyry (Algoman)

Intruding the schist, on the Davidson, Otisse, and other claims to the northeast, there is a reddish porphyritic rock, that outcrops at various points. Owing to the great amount of drift and the intrusion of diabase dikes it was not determined whether the porphyry occurs as an irregular dike or as a series of stock-like bodies. On the Davidson claims, numbers 5372 and 5374, the porphyry is very irregular, as determined by trenching, and has a somewhat oval shape, with greatest

width of about 300 feet. On the line between the northeast Davidson claim (5375) and the Otisse claim (5379), the porphyry has a width of at least 450 feet, and is probably even wider, since the rocks are drift-covered to the south.

In most of the rock phenocrysts of feldspar can be observed. Under the microscope these prove to be orthoclase. The groundmass is largely feldspar of similar composition. Chlorite is present in small amount. Crystals of iron pyrites are abundant in the rock, and in surface specimens are partly altered to limonite. In addition there are quartz and calcite veinlets and replacements of the same minerals.

On the surface the rock is partly oxidized and discoloured by iron oxide stain. In one trench on the Davidson an excavation over six feet in depth was made with pick and shovel in loose rock. The weathering has also broken down large dome-like masses of porphyry into loose fragments, as seen in the illustration.

There are numerous quartz veinlets in the mass of porphyry. These are seldom over three inches in width, and most of them are fractions of an inch. These

Fig. 6.—A hummock of orthoclase porphyry, weathering to small fragments, on Davidson claim 5372.

irregular veinlets give the porphyry the character of a stockwork. Samples of porphyry with quartz are occasionally encountered on the surface, showing visible gold, and the decomposed earthy surface will usually show gold in panning.

At the west end of the outcrop on the Davidson, near the contact, the porphyry contains quite large crystals of orthoclase, nearly an inch in length, and a similar rock is seen in a dike of porphyry extending northwesterly on the Robb claim, 5399. Any extension of similar porphyritic rocks to the west is concealed by a thick covering of conglomerate of the Cobalt series.

An analysis of the orthoclase porphyry, by W. K. McNeill, Provincial Assayer, shows the following percentage composition: Silica 61.80, alumina 18.86, ferric

oxide 2.95, ferrous oxide 0.32, lime 0.63, magnesia 0.31, potash 8.86, soda 3.19, water 0.54, carbon dioxide 0.84, pyrite 1.45; total 99.78.

The small stock-like masses of orthoclase porphyry on the Davidson and Otisse claims are probably of the same relative age as the syenite of Cairo township.

The high percentages of potash in the two rocks suggest a similar origin, while the different crystallization expressed may be due to the relative size of the intrusive bodies.

Cobalt Series

In the southerly part of the area covered by the accompanying map there is a wide extent of rocks of the Cobalt series, consisting of conglomerate, quartzite and slate-like greywacké, similar to other numerous exposures over a wide extent of

Fig. 7.—Conglomerate hill (Cobalt series) west of Davidson discovery.

country from Cobalt northwesterly to Porcupine, and named by W. G. Miller from the occurrence of these rocks with the silver deposits at Cobalt.

The series is generally in a nearly horizontal attitude of gently undulating rolls, seldom with greater dip than twenty degrees. Along the south boundary of Powell the sediments dip gently to the east at 5° to 15°. East of Davidson creek a section shows in ascending order quartzite, slate, conglomerate, quartzite, greywacké and conglomerate. Twenty chains east of the southwest corner of Powell township a cliff facing west exposes 18 feet of reddish weathering greywacké, overlain by 12 feet of conglomerate, with southeasterly dip of 5 to 10 degrees.

However, along the north shore of the main Montreal river, one and one-half miles west of Fox rapids, the rocks of the Cobalt series, quartzite and conglomerate,

are more highly tilted, to nearly 45 degrees. This may be due to a fault along this part of the river, which shows such a marked dissimilarity between the rocks on the different sides. A conglomerate just west of the mouth of the creek flowing from Knott lake has been rendered somewhat schistose, but contains the usual large fragments of Algoman (?) granite and syenite.

Unconformity at Base of Cobalt Series.—Basal conglomerate is exposed at numerous points extending from the West branch to near Fox rapids. One-quarter of a mile northwest of No. 1 post, claim 5374, there is a striking unconformity between the Cobalt series conglomerate and the Keewatin. Here the old surface

Fig. 8—Flat-lying sediments of Cobalt series in the east part of Yarrow township.

consisted of a banded schistose sediment which had been intruded by a diabase dike about 30 feet wide. Recent erosion has exposed these old rocks to about the original surface on which the Cobalt conglomerate was deposited, as there are thin skins of isolated patches of conglomerate at several places. This conglomerate contains large fragments of the old sediment and also of the diabase, and the line between the old schist and the later conglomerate is very distinct. The material here has been derived from local rock rather than by glacial transportation from a distance, but the old pre-Cobalt series surface, from the present evidence, would indicate a rather smooth rounded outline.

Other similar unconformities can be observed just west of No. 2 post, claim 5383, and on claim HF 13, west of Fox rapids.

On the northeast shore of Moyneur lake, in Cairo township, the conglomerate lies unconformably on the syenite. There is a similar relationship exposed in a cliff on the west side of the beaver meadow that extends southerly from Cameron lake. Here the conglomerate was deposited on a steep surface.

On the east shore of Mistinigon lake, opposite the north end of Bell island, there is a hill of conglomerate which overlies Keewatin. On the north side of the hill the Keewatin consists of chert or iron formation, that extends along the shore for a quarter of a mile. Fragments of the chert are included in the base of the conglomerate.

Diabase

Diabase occurs abundantly in parts of the area. The Keewatin and the intrusives (granites, syenite and porphyry) are cut by numerous dikes of diabase;

Fig. 9.—Unconformity, claim 5383, between conglomerate of Cobalt series (light-coloured patch), and underlying dark-coloured Keewatin, intruded by diabase.

whereas in the rocks of the Cobalt series these dikes are quite rare. In the vicinity of the Davidson claims there are several dikes of diabase that lie unconformably below the basal conglomerate of the Cobalt series. These dikes intrude the orthoclase porphyry that has been classed with the Algoman intrusives. It is probable that most of the dikes are post-Algoman and pre-Cobalt series in age.

The dikes ordinarily are of the normal type, medium-grained, showing chiefly plagioclase feldspar and augite with some interstitial quartz.

Occasionally porphyritic varieties that contain large phenocrysts of greenish feldspar up to two and three inches in diameter are observed. One of these occurs on

the north line of Alma, 20 chains west of the second mile post. It contains greenish porphyritic feldspar in a coarse matrix of labradorite and augite with magnetite.

There are several narrow dikes of porphyritic diabase intruding Keewatin rocks along the trail north of Davidson creek.

On the east shore of the southwest bay of Squaw lake in the Indian reserve there is a hornblende diabase. Small rods of plagioclase are set in crystals of hornblende and hypersthene. Interstitial quartz is abundant, and magnetite occurs in small grains.

Fig. 10—Dike of porphyritic diabase on trail to Davidson camp from Montreal river.

Pleistocene

Deposits of unconsolidated material cover a great part of the area. These consist largely of sand and gravel accumulations of glacial origin. A wide stretch of sand and gravel in the form of a rolling plain occurs in the southeast part of Cairo and the northeast part of Kimberley. This plain is crossed by the Long portage. There is an esker-like ridge on the south boundary of Cairo, just west of Whiskey Jack creek. The Height of Land portage at the north end of Matachewan lake is over a sand plain, probably an outwash plain from a glacier.

Morainic ridges of boulders are seen two miles up the East branch of the Montreal river, and the trail from the Montreal river to the Davidson claims follows along a similar ridge.

Economic Geology

The chief interest in the area is in its possibilities as a gold producer. For some years gold has been known to occur in Cairo and Alma townships, but it was not until the discovery on the Davidson claim in Powell in 1916 that the area attracted much attention.

Since only a small part of the area has been closely examined by the prospectors, it is possible that other promising finds will be made in the Keewatin areas in Powell and adjoining townships. The Keewatin rocks near the contact with the intrusive syenite in Cairo and Alma townships should be worthy of close examination, and it is possible that other small masses of orthoclase porphyry, similar to the occurrences on the Davidson and Otisse, will be found. Prospecting is, however, rendered difficult by deposits of sand and gravel over much of the area.

Gold in Cairo and Alma Townships

Gold was found by Jake Davidson, a prospector, in the sand-gravel stretches to the north of the Montreal river, near Fox rapids; the writer is informed by him that he frequently obtained colours in the pan, but found no place where there was any placer workable under present conditions.

Gold occurs in quartz veins in some parts of Cairo and Alma townships.

Craig Claims.—The Craig claims are situated about three miles north of Fox rapids. Here a wide quartz vein was discovered with a north and south strike. At one place trenching has shown a width of 150 feet of quartz, and silicified and brecciated syenite which is the wall rock of the vein. Part of the vein material is somewhat felsitic in appearance, suggesting some fine-grained igneous rock related to the syenite.

At one point a shaft has been sunk about 60 feet, with short drifts on the vein, and fine visible gold has been reported in the shaft and drifts, and in samples on the dump. No gold, however, was seen by the writer, but samples of material from the dump showed low values in gold. A little iron pyrites was observed in pieces of quartz and syenite, but generally the sulphide is in very minor quantity. The property is equipped with a small steam hoisting plant and has a good set of mine buildings.

Chief Claim.—The Chief claim (17310) is situated about 20 chains west of the two-mile post on the east boundary of Alma. A discovery of gold in a small hummock of syenite, which outcrops in a beaver meadow, was made some years ago. The vein strikes E. and W. and is quite narrow, varying in width from a mere crack to about six inches where exposed for 30 feet. A few shallow pits were sunk on the vein, and some samples rich in gold are reported to have been taken from the westerly pit, which was filled with water at the time of the visit. A sample of vein material from the dump, consisting of quartz, chalcopyrite, and a little galena, gave an assay of $4.40 in gold. Attempts were made by trenching to pick up the vein on the hill to the east, but only mere stringers were found, a sample of which showed no gold.

Brookbank Claim.—This claim (17801) lies in the southeast corner of Alma township, where the rock is a red syenite. Some work has been done about four chains west of the east boundary of the township and just northeast of the cabin, which is on the boundary. Here there is a N.-S. vein on which two pits had been sunk. The vein is about two inches in width between the pits, showing for 30 feet. The vein filling is chiefly quartz, but contains also some galena, copper pyrites, pyrite, and some barite and fluorite. No gold was observed, but one assay of two inches of vein contained $5.20 in gold and 8 oz. in silver, while another of five inches in width from the north pit gave $7.60 in gold and 8 oz. in silver.

Cooper Claim.—Gold is also reported on the Cooper claim (MR 5645), which lies nearly a mile northwest of the Brookbank.

The above properties were not being worked during the summer of 1917, and there were only a few prospectors in Cairo and none in Alma.

Fig. 11.—Large boulders of auriferous quartz and schist, Davidson claim 5372.

Gold in Powell Township

Davidson Claims.—These claims are situated in Powell township about two miles west of the Montreal river. Gold was found by Jake Davidson in 1916, on the south part of claim 5372, in a mass of quartz and schist. This deposit strikes nearly east and west, and has been traced by trenching for 225 feet. It dips 60°S., is 40 feet wide at the west end, and narrows toward the east. The quartz is very irregularly distributed in the schist, and for the most part the veinlets or quartz masses are transverse to the strike. The deposit very probably is lenticular in form. To the southeast there are a number of huge boulders of material from this deposit. The surface of the schist is weathered to a brown

rust, largely due to the oxidation of the iron in the ankerite, which forms a part of the altered rock. There is also a proportion of bright green serpentinous mineral. Gold in a state of very fine division was noted at a few places in this deposit. The only sulphide observed is a little iron pyrites, but for the most part the deposit is deficient in mineralization. A few chains southeast there is a quartz vein on which a pit had been sunk some years previously by Steve Lafricain, of Fort Matachewan. This quartz vein contains small quantities of cobalt bloom, iron and copper pyrites, which first attracted attention, but promising values in gold or silver were not obtained on assay.

The Keewatin rocks accompanying these veins are quite schistose, igneous and sedimentary. To the north of the first mentioned deposit there is a whitish altered porphyry which shows phenocrysts of orthoclase and plagioclase in a groundmass

Fig. 12.—Auriferous quartz and schist deposit, Davidson claim 5372.

of feldspar and quartz, with much sericite and calcite. Near this altered porphyry there is ashy weathering chert, or Iron formation. Part of the south wall of the deposit is schistose quartz-porphyry with conspicuous phenocrysts of quartz.

Intruding the schist in the north parts of these claims there is a red orthoclase porphyry that has been referred to previously as gold-bearing. Iron pyrites occurs abundantly in portions of this rock, and there has been considerable oxidation, resulting in the breaking down to a red earthy material or loose fragments on the surface, that has involved a certain amount of surface concentration. This condition varies greatly in different parts of the property; on some of the knolls there are only a few inches or less of oxidized rock, but one trench shows over six feet of loose oxidized material. Consequently, for a proper examination of the deposit, it would be necessary to prospect below this shallow rusty surface by means of open cuts through the weathered rock, by drilling, or by shafts.

The porphyry is cut by numerous veinlets of quartz which in places carry visible gold, that frequently occurs near the contact with the porphyry and also in the wall rock, near the veinlets. In one deep trench there are several flat-lying quartz veins from a fraction of an inch to two inches in width. In other places the quartz veins may be irregular in their distribution, the whole mass occurring like a stockwork. It is quite likely the quartz veins are genetically connected with the porphyry, being the filling of tension cracks that have developed on the cooling of the rock, while the gold has accompanied the quartz in the formation of these veins. Sometimes gold can be observed deposited on grains of iron pyrites in the quartz or along the wall rock. A few samples were taken from the Davidson by the writer. One of these, from the surface of the porphyry in a trench on claim 5372, gave on assay $10.00 per ton over a length of 15 feet. The porphyry here was not so altered as is frequently seen, but visible gold was observed in minute quartz veinlets near the place from which the sample was taken.

Another surface sample from a long trench at the northeast corner of the claim gave on assay a value of $15.20 over a length of ten feet in the trench. Several specimen samples of quartz and porphyry carrying iron pyrites gave values of 80 cents to $2.00 per ton. None of these assays are quoted as representative of the actual value of the whole mass of the porphyry, but indicate its gold-bearing character. It may be found on extended examination that there are isolated parts of the porphyry which are sufficiently enriched with gold to be of economic value.

The following is a description of a microscopic examination of gold-bearing porphyry and quartz from Davidson claim 5372:

Orthoclase crystals are set in a groundmass of smaller feldspar crystals with a little chlorite in flakes and scattered crystals of apatite. Calcite is abundant as a secondary mineral. Quartz occurs in small secondary masses and in veinlets. Cubes and irregular grains of pyrite with an oxidized surface of limonite are frequent in the porphyry and also in the quartz veinlets. The quartz veinlets contain clear secondary feldspar, plagioclase and microcline moulded on the older feldspars of the porphyry. Vein calcite also accompanies the quartz in the veinlets, while native gold occurs near the wall rock in the quartz. A small amount of copper pyrites is occasionally seen. None of the rarer minerals, like the tellurides, have been recognized in any of the samples examined.

Otisse Claims (5379-5380).—These claims lie directly east of the Davidson group, and, owing to a somewhat deeper covering of drift and a smaller amount of trenching, the distribution of the rocks is not as well known.

In the northwest part of claim 5379 the orthoclase porphyry is well exposed. There is also a surface oxidation similar to the Davidson, with an amount of loose brown earthy material in which trenches were made. Gold has been found in a number of pits in the same association as in the porphyry on the Davidson.

To the east of this outcrop other occurrences of porphyry have been located by Sam Otisse in heavily timbered country; it is probable that a band of porphyry extends through the northerly part of the claims.

Near the centre line of the claims, a few chains north of the south line, there are outcrops of rusty weathered schist in which native gold has also been discovered.

This band of rock lies to the south of the porphyry band. Below the oxidized surface the rock is light grey in colour and spotted with pyrite. Examined under the microscope it contains much secondary silica, calcite, sericite, and iron pyrites, indicating that the rock has been entirely altered by replacement from its original composition. Mr. Otisse discovered gold at several other places on his claims in rocks which are of different character from those described above.

An examination of these properties in January last resulted in options being taken on these and adjoining claims, and it is expected that during the summer of 1918 a thorough examination will be made to prove their possibilities as gold producers.

Otisse Claim (5376).—This claim lies north of the Davidson claim, 5372. The rocks are largely schistose sedimentary rocks intruded by narrow porphyritic dikes. Six chains north of the Davidson claim there is a quartz vein striking nearly east and west, and three to four feet wide in places. It contains, in parts, copper pyrites, iron pyrites, and galena. Fragments of grey porphyry in the quartz suggest that the vein was formed along an old porphyry dike. Gold values are reported from this vein. A selected sample of quartz, galena, and copper pyrites contained $1.20 in gold per ton.

In the southwest part of the claim there is a narrow red porphyry dike that strikes northwesterly to the Robb claim. It contains quite large crystals of orthoclase, and is probably a narrow dike representative of the stock-like mass of red porphyry on the Davidson. Gold is reported to occur in this dike.

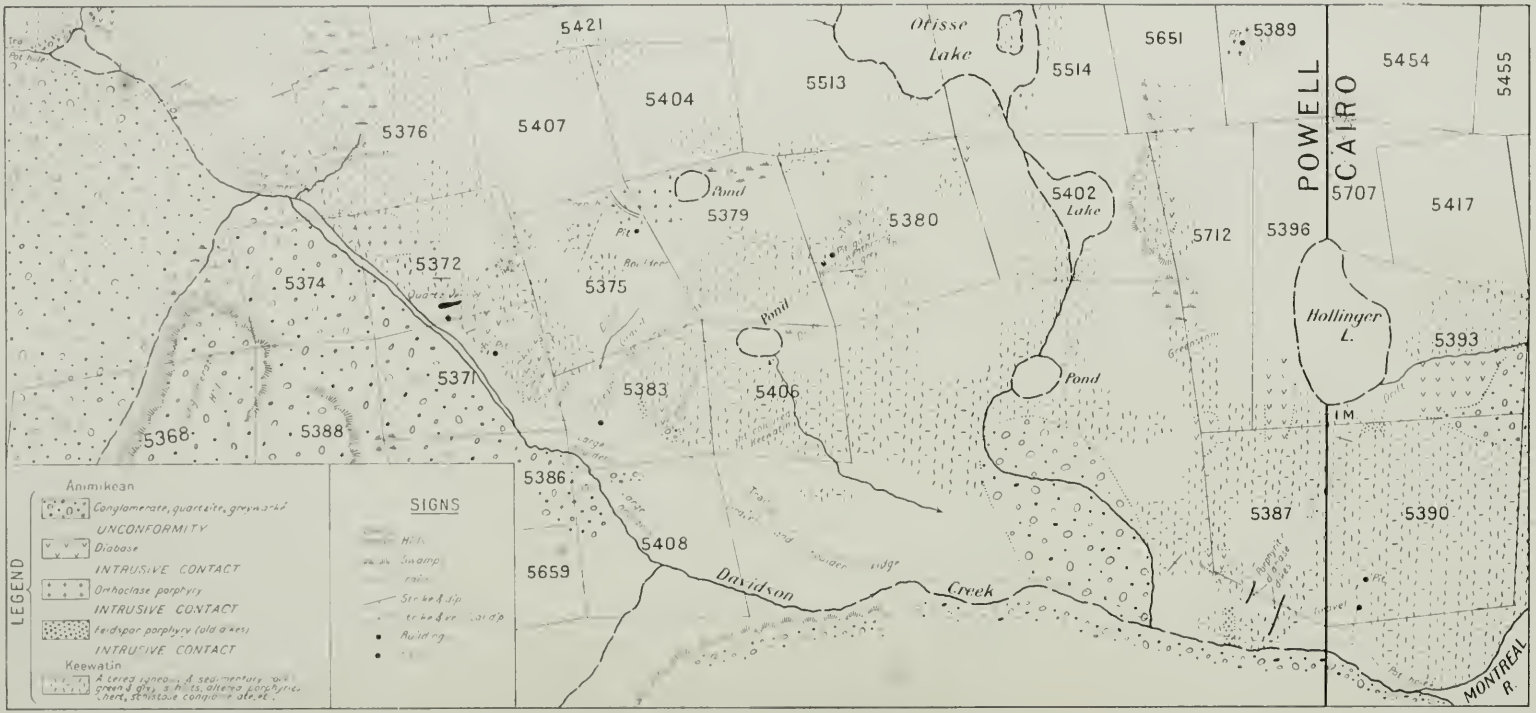
O'Connell Claims (5389-5390).—On claim 5389, adjoining the boundary line between Powell and Cairo, there is a reddish feldspar porphyry dike that intrudes a slate-like rock of Keewatin age. This porphyry is much harder than that on the Davidson and Otisse claims, and does not show so heavy a mineralization with iron pyrites. It is cut by quartz veinlets, and has been partly prospected by stripping and a shallow open cut. Low values in gold from this material are reported by the owners.

On claim 5390, one mile south, work was done on a band of blackish chert-like rock cut by quartz veinlets with pyrite, from which low gold values were also obtained.

Fluorite

Fluorite (fluorspar) has been found in small quantity in a number of quartz veins in Cairo and Alma townships, but none of the deposits examined are of commercial value. Owing to the widespread occurrence of the mineral, it is possible that prospecting might result in the finding of economic deposits. The mineral is of a deep purple colour, occurring in small masses in the quartz or in the wall rock adjacent to the veins. It is also present in the Biederman barite vein. One occurrence where the fluorite is in the quartz is on the Harvey claim, No. 18285, west of the road from Fox rapids north to the Craig claims. This vein is about seven inches wide, strikes N. 75° E., and has been traced several hundred feet. Some pieces of fluorite, two inches across, were taken from the vein. All the showings of fluorite are in the syenite.

GEOLOGICAL SKETCH MAP OF PARTS OF THE TOWNSHIPS OF POWELL AND CAIRO.



—— MINING CLAIMS ——

Connell—5513, 5514; Davidson—5371, 5372, 5374, 5375, 5383; O'Connell—5387, 5389, 5390, 5651; Otisse—5376, 5379, 5380; Robb—5402.

Barite

Veins containing barite occur in several parts of the area. These are generally small, but two deposits have been found which would be of commercial value were they nearer railway transportation. These are the Biederman deposit in Cairo township, and a deposit near Yarrow lake in Yarrow township.

Biederman Claim.—This claim (16042) is situated on the west shore of Browning lake, in the north part of Cairo township. The country rock is a red syenite in which there is a barite vein with strike N. 65° W. and dip 80° N. The

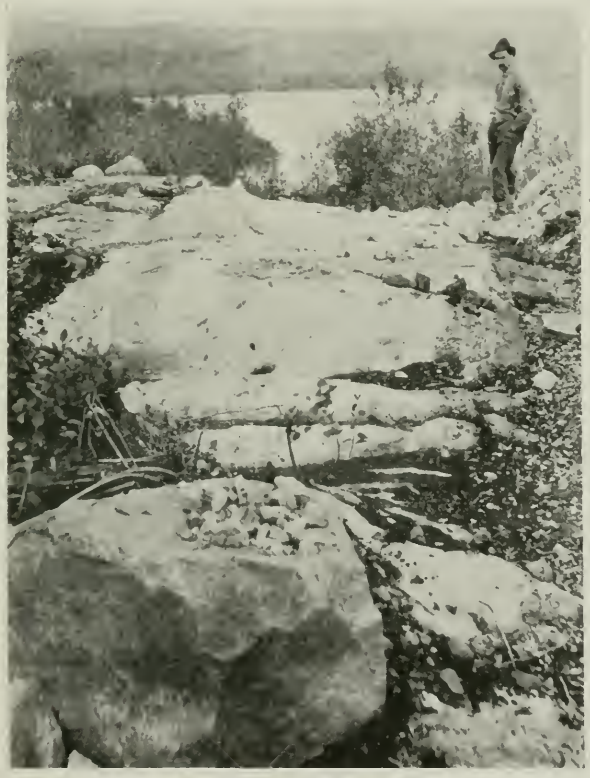


Fig. 13.—Biederman barite vein, on claim 16042, in Cairo township.

deposit can be observed about 100 feet from the shore of the lake where a shallow shaft has been sunk at a point where the vein has been concealed by drift to the east. Here there is a width of 15 feet, and the barite can be traced westerly for 100 feet, decreasing to a width of 7 feet. Beyond this there is drift followed by an exposure of barite about 30 feet in length and three feet wide at the east end, and two feet wide at the west end. The barite is for the most part quite white in colour and of good quality. At the shaft there are minor quantities of zinc blende, galena and specularite and a little fluorite, as impurities. The deposit also contains at this point some large inclusions of syenite. A sample across eight feet, on analysis contains 90.50 per cent. barium sulphate.

Yarrow Deposit.—This deposit occurs along the creek which flows from Yarrow lake to Mistinigon lake. The rocks are slate and quartzite of the Cobalt series, but they are largely concealed by a deep covering of drift along the creek. The deposit was discovered in the bed of the creek, and attempts have been made to open it up by diverting the water by means of a small dam. Two shallow pits were sunk in the bed of the creek on the barite, which is in two veins five feet and six feet wide respectively, separated by a band of quartzite. As the deposit was noted only in the creek bottom its length has not been determined, but owing to its width it is probable that it also has considerable length. This deposit, like the Biederman, will probably be of commercial value at a future time.

Iron Ore

The La Brosse claims, JS 65 and JS 66, situated in Yarrow township, a short distance west of the east branch of the Montreal river, were examined by P. E. Hopkins in August, 1914, and the following account is from his manuscript:

The iron ore, which consists of hematite, in reniform structure and also the highly crystallized specular variety, occurs in a quartz vein that strikes N. 72° E., and dips about vertically. This vein can be traced across two claims, and varies from five feet to thirty feet in width. The iron ore occurs in isolated masses and stringers in the quartz, and in places is brecciated. On the east part of JS 66 is located the largest body of clean iron ore. This ore on the surface is sixty feet long and six feet wide at its greatest width, being in the form of a lens. Another lens is twenty-five feet in length. More work may prove the bodies to be larger, as the vein is partly drift-covered. No kidney ore was observed in other parts of the vein where exposed, but small quantities of specular iron ore occur sparingly in the vein.

Iron ore was observed in small quartz veins in the vicinity in Yarrow township. The country rock that encloses the veins is conglomerate and quartzite of the Cobalt series that dip gently to the east at 10° to 15°.

Waterpower[1]

Mining camps in northern Ontario have been greatly favoured by the proximity of waterfalls capable of development for the generation of hydro-electric energy. Powell township is well situated in this regard. Big Bend or Matachewan falls lying about six and a half miles north of the Davidson and Otisse claims. This water power is located in the township of Baden on the west branch of the Montreal river at a point known as the Great Northern Bend.

Application to develop this power was made in 1916 by a firm of engineers and surveyors, Sutcliffe and Neelands, of New Liskeard, with the object of supplying electric energy to the prospective gold camp in Powell township, and possibly the Gowganda silver camp some twenty miles farther south. Regarding their exploratory surveys in 1900, De Morest and Silvester, with party No. 3, report[2] as follows:

Matachewan falls and rapids, where the river empties into Matachewan lake, have a drop of about forty feet and constitute a very important waterpower, as the length is short and the site comparatively easy of development.

[1] The notes on Waterpower have been supplied by W. R. Rogers, Topographer for the Ontario Bureau of Mines.

[2] Report of Survey and Exploration of Northern Ontario in 1900, p. 87.

The watershed of the West branch is 790 square miles in area. Under natural head the drop at Matachewan falls and rapids is 41 feet, but a dam raising the water at the upper level to high water mark would give a head of 45 feet. Assuming a run-off coefficient of 0.3 cu. ft. per sec. per square mile of drainage area for minimum flow conditions, the possible development without storage would be about 1,000 horsepower.

Permission has been sought to raise the level of Mistinigon lake 25 feet in order to provide storage and also to increase the available head to 70 feet. Another project involves the diversion of the East branch of the Montreal river by way of Kawakinika lake, Cleaver lake and Cleaver creek, to a point on the West branch

Fig. 14.—Matachewan or Big Bend falls, Montreal river, where the West branch enters Matachewan lake.

near the centre of the township of Rankin, a route that marks a former course of the river. Such a diversion would add 210 square miles to the drainage area, making a total of 1,000 square miles, and could be effected by erecting a dam at the first rapids below Obushkong lake near the boundary line between the townships of Haultain and Morel. Both of these projects were suggested late in the fall of 1917, and either or both may not be prejudicial to other interests, such as navigation and lumbering. A Departmental examination of the feasibility of the plans had to be postponed until navigation opened in the spring of 1918. Undoubtedly work on this power will proceed in the near future, the extent of the development depending on the success met with in mining operations in the vicinity.

Acknowledgments

The writer was ably assisted in the field by J. E. Hawley, student of Queen's University, Kingston, from June 1st to late in September, after which Wm. McDonnell, of Elk lake, rendered good service till the close of the season late in October.

Geo. Bruce, Haileybury, who was in charge of operations at the Davidson claims, and J. Hollinger, in charge of the O'Connell claims, extended many courtesies to the writer while geological work was being done in the vicinity of these properties. Messrs. Bastian and St. Paul, prospectors at Fox rapids, gave material assistance in connection with the work in Cairo, Alma, and the Indian reserve.

Thanks are also due to A. J. Browning, late Mining Recorder at Elk Lake, for giving assistance to the survey party.

The assays mentioned in this report were made at the Provincial Assay Office, Toronto.

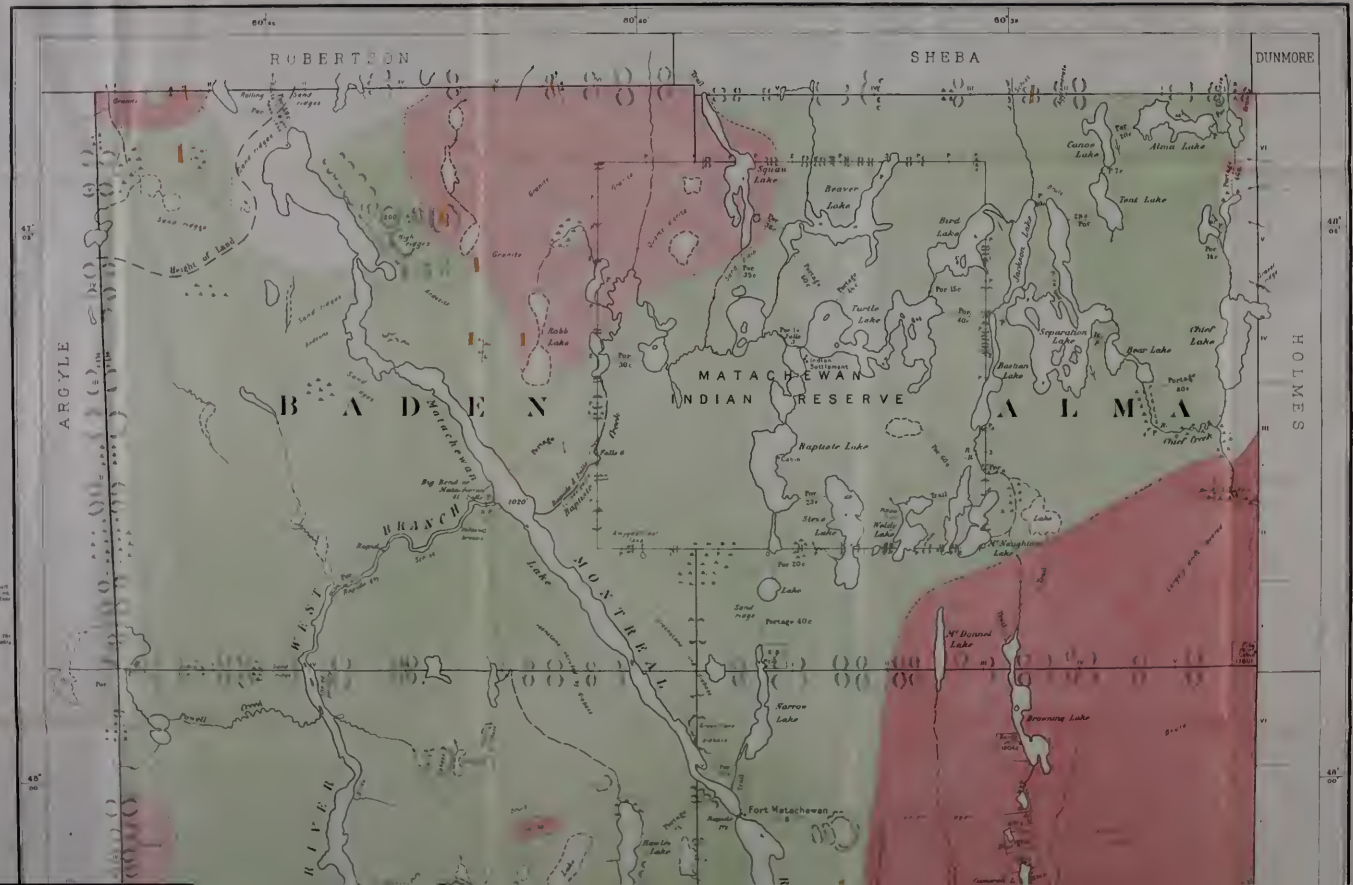
INDEX VOL. XXVII, PART I

End of Part I.

PROVINCE OF ONTARIO

BUREAU OF MINES

G. H. Ferguson, *Minister* — Willet G. Miller, *Provincial Geologist*



LEGEND

PRE CAMBRIAN

Algomian (Cobalt Series)

Conglomerate, quartzite, greywacke slate.

UNCONFORMITY ?

Algoman

Orthoclase porphyry

Hornblende syenite

Hornblende granite quartz diorite

Laurentian ?

Granite and gneiss

INTRUSIVE CONTACT

Keewatin

Complex of altered igneous rocks, metabasalt, andesite, porphyry, diabase, felsite, serpentine, pyroxenite fragmental, iron formation, and minor conglomerate and quartzite.

Diabase

Certain dikes of diabase intrude rocks of the Cobalt series, but most of them are probably post Algoman and pre-Cobalt in age.

Symbols

Glacial Striae

Strike and Dip

Strike and Vertical Dip

Geological Boundaries

NOTES

The Matachewan gold area is located on the Montreal river in the District of Timiskaming. The nearest railway station, Elk Lake, the terminus of a branch line of the Timiskaming and Northern Ontario railway, is 21 miles in a direct line southeast of Powell township where gold discoveries have been recently made. From Elk Lake there is a winter road to the Davidson claims, but during the open seasons the Montreal river is utilized as a canoe route to the area, the journey from Elk lake requiring a long, hard day's trip. For several years gold in quartz veins has been known to occur in Cairo and Alma townships. Alluvial gold in small quantity has been found in the sands and gravels to the northeast of Fox rapids. In 1910 gold was found in a quartz schist formation on the Davidson claims, and in 1917 further discoveries were made of gold in an orthoclase porphyry on the Otisse and Davidson claims and in a pyritous grey schist on the Otisse.

Geology

Keewatin.—The compact rocks are all referred to the pre Cambrian. The oldest and most widespread are those of the Keewatin, that consists of a complex of volcanic rocks like basalt, andesite, porphyrite, soda rhyolite, felsite, and a subordinate amount of fragmental rocks like slate, quartzite, conglomerate, and cherty iron formation. These very old rocks are frequently altered to schists and are impregnated with secondary silica, carbonate of lime, magnesia and iron, and pyrites. They are frequently intruded by narrow dikes of diabase and porphyry and larger areas of diabase, syenite, granite and gneiss. Rocks of Keewatin age can be well observed in the vicinity of Fox rapids and north of Davidson creek in Powell and Cairo townships.

Granite and Gneiss.—These rocks occur together in the south part of Cairo and the north part of Kingsmere. Banded gneiss can be seen to the north of the Long Portage where the rock is a blackish glistening hornblendic variety; these rocks are probably of Laurentian age.

Syenite.—There is a batholith of hornblende syenite in Cairo and Alma townships. In this rock there are veins containing gold, fluorite and barite.

Orthoclase Porphyry.—Small stocks of orthoclase porphyry occur on the Davidson and Otisse claims in Powell township. This rock contains gold with pyrite in narrow quartz veins and wall rock.

Granite.—There are several small areas of hornblende granite in Yarrow, Powell, Baden and Alma townships.

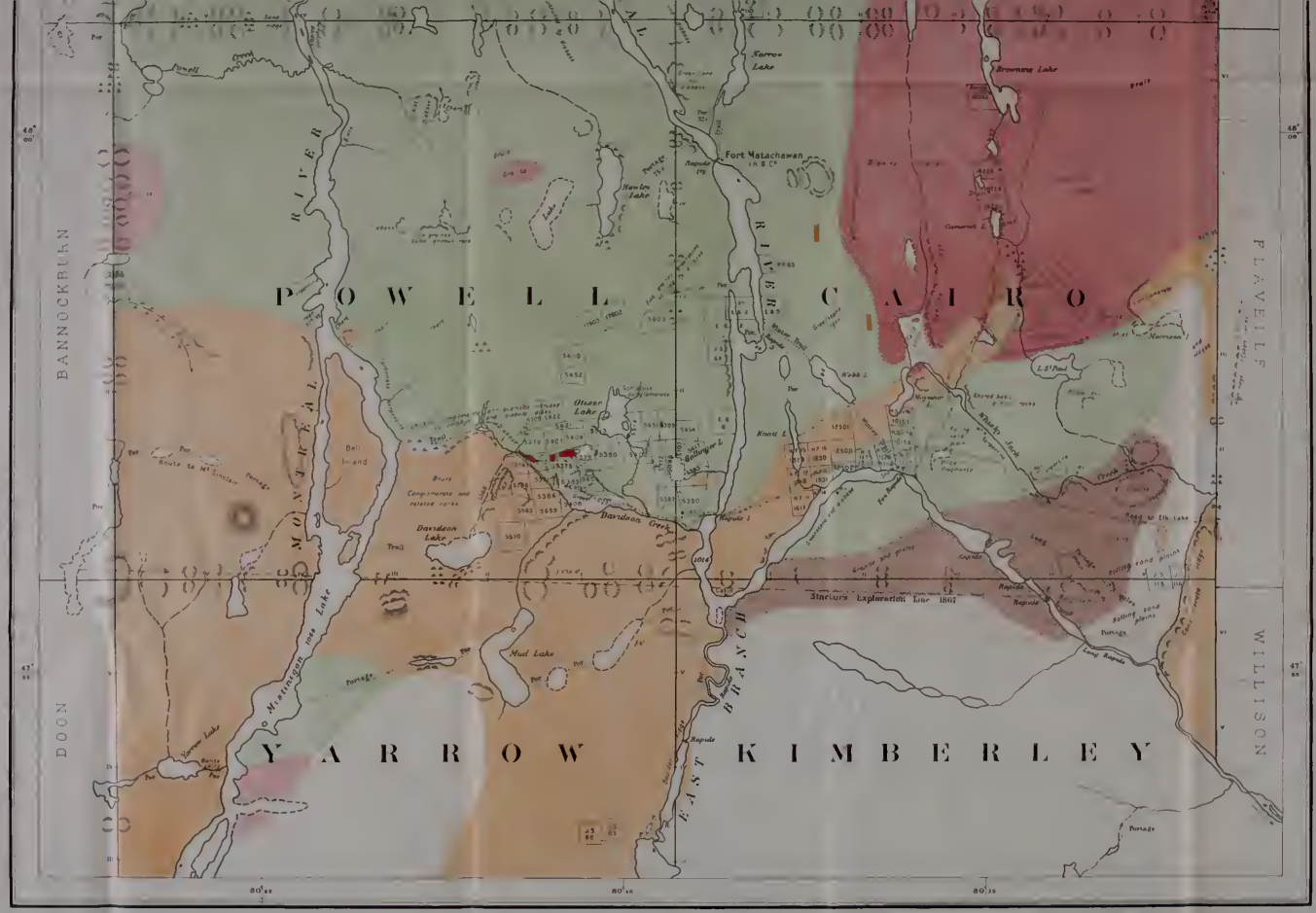
Cobalt Series.—There is a wide extent of nearly horizontal sediments of the Cobalt series in Yarrow, Powell and Cairo. These consist of conglomerate, quartzite and greywacke. Numerous unconformities occur between this series and the older syenite, porphyry, diabase and greenstones.

Diabase.—Dikes of diabase are of frequent occurrence in all the rocks earlier in age than the Cobalt series, whereas there are only a few dikes in the latter rocks. It is probable that most of the dikes of diabase are post-Algoman and pre-Cobalt in age.

Pleistocene.—The area is greatly covered with drift deposits that are largely of glacial origin, consisting of sand, gravel and boulder accumulations in moranic and esker ridges, outwash plains and other forms of glacial deposits.

Economic Geology

Gold.—The gold deposits in Cairo and Alma townships consist of quartz veins in the syenite. Narrow quartz veins on the Brookbank and Chief claims in Alma contain low values in gold and silver on assay, while on the former claim the quartz carries some fluorite, barite, copper pyrites and galena. On the Craig claims in Cairo there is



Sources of Information

Township and mining claim plans Surveys Branch, Department of Lands, Forests and Mines, Ontario
Matachewin survey of lakes, rivers, &c., and Geology, by A. G. Burrows
Aneroid and other determinations of elevations are based on Cowganda lake, 1185' (White's Altitudes)
Drawn for photolithography by W. J. Bell

Symbols

Glacial Striae

Strike and Dip

Strike and Vertical Dip

Geological Boundaries

Mine or Prospect Pits

Buildings

Roads

Trails

1050

Altitudes
(in feet above sea level)

Hills

Swamp or Muskeg

Township and mining claim plans Surveys Branch, Department of Lands, Forests and Mines, Ontario. *Matachewin* survey of lakes, rivers, &c., and Geology, by A. G. Burrows. *Aneroid and other determinations of elevations are based on Cowganda lake, 1185' (White's Altitudes)* Drawn for photolithography by W. J. Bell

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The gold deposits in Powell township occur in rusty weathering grey schist, reddish orthoclase porphyry and a wide quartz-schist vein on the Davidson.

The orthoclase porphyry occurs as small stocks that are intersected by numerous veinlets of quartz, some of which carry gold associated with iron pyrites. The porphyry itself is impregnated with iron pyrites which at the surface has been partly oxidized with the formation of iron oxide and a breaking down of porphyry into irregular fragments at different points. The porphyry outcrops are from 300 to 600 feet in width in places and have the character of stockworks. Gold has been found on several claims of the Davidson and Otisse groups in this rock. In the rusty weathering grey schist on the Otisse claims gold is finely disseminated in specimens from pits. The grey rock contains fine silica and carbonate of lime, magnesia and iron, and also numerous grains of iron pyrites. These minerals have probably resulted from a metasomatic replacement of the rock by circulating solutions.

Gold also occurs on the Davidson in a quartz and schist vein that has been traced for 225 feet by trenching. The strike is east and west, and the deposit is 40 feet wide at the west end, narrowing to the east.

Barite—A wide vein of barite in syenite occurs on the Biederman claim (16042), in the north part of Cairo township. There are other barite veins in the northwest part of Yarrow township, near Yarrow lake.

Fluorite—Fluorite or fluorspar has been found in small quantity in several veins in Cairo and Alma townships.

Iron Ore—Hematite occurs in lenses in quartz veins on the La Brosse Claims (J.S. 65 and 66) in Yarrow township, west of the east branch of the Montreal river.

MINING CLAIMS

IN POWELL

5371-74 S. 5383	Davidson
5379, 5380, 5376	Otisse
5402	Robb
5389	O'Connell
5513, 5514	Connell

IN CAIRO

5390	O'Connell
16217-16219	Craig
16042	Biederman

IN ALMA

17801	Brookbank
17340	Chief

IN YARROW

J.S. 65 and J.S. 66	La Brosse

Map N° 27 a

MATACHEWAN GOLD AREA

DISTRICT OF TIMISKAMING

To accompany Report by A.G. Burrows, in Part I, Volume 27, of the Ontario Bureau of Mines

1918

Scale 4" = 1 Mile or 1/4 Mile = 1 Inch

Chains — Miles

Metres — Kilometres

Ontario. Dept. of Mines
Annual report